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Solar Maximum Mission

A closer look at the Sun

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Vol 87 No 1208 3 July 1980

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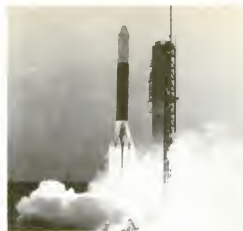
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The Solar Maximum Mission—NASA's latest satellite to look at the Sun—takes off from Cape Canaveral.

The satellite is observing solar flares in an attempt to unravel processes underlying these enormous bursts of activity. The article on p 45 describes some of the mission's successes and presents colour images of the Sun published for the first time.

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Comment

Liberate the truth

"Horror Farm"—the Agricultural Research Council's Institute of Animal Physiology at Babraham near Cambridge—has hit the headlines again. Not through its own activities, but through the activities of a coalition of self-styled animal lovers who took it upon themselves to raid the institute to secure evidence of the "horrific" experiments that take place behind Babraham's blacked-out windows. Members of the various Animal Liberation Leagues said afterwards that their hooliganism was motivated by the desire to secure evidence to lay before the public which, they remind us, pays for the work. They got their evidence, 10 rolls of film and a garbled report of an animal that was either a cross between a goat and a cow or else a goat the size of a cow, but as yet have not released the sickening material.

Deploable though their stormtrooper tactics undoubtedly are, the Liberation Leagues do raise important points. One is an old chestnut: an animal whose condition makes you suffer is not necessarily suffering itself. Implanted electrodes and windows in the stomach are not, of themselves, likely to cause pain. The Libbers don't burst into hospitals to take pictures of people with cardiac pacemakers, yet the technology is identical.

More important, though, is the whole question of secrecy in research and the scientists' response to this kind of threat. Lord Halsbury's Laboratory Animals Protection Bill, which recently went through the committee stage but is effectively starved of government support and stands little chance of becoming law, would have fostered a climate in which researchers would feel free to talk about the value of their work, and those who disagreed would have a forum in which to be heard. But the government, despite pledges in its election manifesto and subsequent promises to replace the Cruelty to Animals 1876 Act, pleaded poverty when faced with Halsbury's forward-looking Bill (*New Scientist*, 26 June, p 574).

Nothing is going to abolish vivisection overnight. The Halsbury Bill offered a chance to decrease the number of animals abused. If the Animal Liberation Leagues would only accept these political truths they could campaign effectively for much-needed reform. As it is they do their more sensible colleagues down by driving a wedge between scientists and the people they serve.

Jeremy Cherfas

Please adjust your policy

By an unhappy coincidence, the figure of £2000 million has cropped up twice in the past week with regard to Britain's ailing industries. The taxpayer will need to find something like this sum to keep British Steel afloat for another year. And the trade union members on Sir Harold Wilson's committee of inquiry into Britain's financial institutions want to pour the same figure, through a government-run investment bank, into manufacturing industry each year to keep it competitive with the rest of the world.

The harsh reality is that the Industry Secretary, Sir Keith Joseph, will be forced to countenance a £2000 million hand-out to British Steel: to do anything else would cause a gigantic political row. But as there is no pressing political reason to do anything about the much more important question of the rest of industry, Sir Keith will continue to pay lip-service to ideas about helping it to reshape itself.

Sir Keith's industrial strategy—if he can be said to have one—is to create stable economic conditions that will allow firms to flourish. But in the experience of most

industrialised countries, something more than this is needed. The industry supremo was forcefully reminded of this by a recent report from Geoffrey Chandler, the director general of the National Economic Development Office. The report lists a series of what Chandler calls "adjustment policies" in other European countries. The measures aim to "reduce the inertia which can lead to slow industrial adaptation to such major changes in the economic environment as the oil crisis, industrialisation in the Third World or rapid technological changes".

Among other things, the document tells us that West Germany is spending £96 million per year on supporting small businesses (the cash often helps to pay for R&D staff); the Netherlands grants £90 million annually to high-technology firms to help them with research costs; and the Swiss have a £13 million project to encourage the adoption of new electronic techniques. Chandler is not so bold as to tell Sir Keith that in virtually ignoring such measures he is on the wrong track. But on the evidence of the report, these policies are part of the industrial scene in just about every developed European nation except Britain.

Chandler's message is that British industry is not ticking over as well as the government might wish. If Sir Harold's committee did nothing else, it made plain the fact that the relationship between financial institutions and industry is complex. And sometimes Sir Keith's beloved free-market mechanisms are not enough to keep it working properly. In particular, innovative activities that can generate wealth aren't always backed in the way they might be. It would be helpful if we had an Industry Secretary who—even if he didn't immediately propose startling solutions to remedy the problems—made a start by admitting that the problems exist.

Peter Marsh

Confusion in Europe

The endorsement of the US's fusion energy programme by a high-level review committee underlines the poverty of Europe's own fusion effort. Our next big machine, the Joint European Torus (JET), may be as good as their Tokamak Fusion Test Reactor, it may even be scientifically superior, but one machine does not make a fusion programme. It took the EEC years to agree on a site for JET; since then Europe's fusion planners have achieved little. In the US, the Department of Energy has started work on two alternatives to the tokamak—the Mirror Fusion Test Facility and the Elmo Bumpy Torus—a large design team is working on the tokamak that will come after TFTR, and a sizeable technology programme is under way. In Europe our only thought for the future seems to be to send a handful of people to talk about Intor, a grandiose international research project that almost certainly is going nowhere (*New Scientist*, 12 June, p 230).

There are projects seeking support in Europe, but the EEC seems to be more interested in the trade in dead sheep and apples than in the future of its energy research effort. The US reckons it will cost \$50 million to design the post-TFTR machine, and if it starts work now on that machine, the device, variously known as ETF or FED (see opposite), will be ready for the DoE to order parts after TFTR has been working for two or three years. If Europe isn't going to have a large gap between JET and whatever comes after it, then decisions are needed now. And if we are to have any option other than the tokamak then some of the candidates for national and Community support should be approved before the year is out. As it is, in Brussels they are still arguing about JET. Michael Kenward

This week

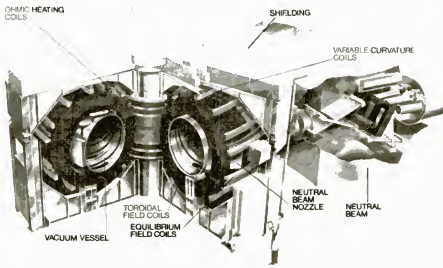
Ten-year countdown to fusion

An independent high-level review of the US's fusion research programme calls for the construction between now and 1990 of a large tokamak fusion machine, the Fusion Engineering Device (FED), at a new Center for Fusion Engineering. The fusion community in the US sees the report from the Fusion Review Panel of the Energy Research Advisory Board as a strong endorsement of its work, although the study contains some recommendations that could lead to substantial changes in the existing fusion effort of the US Department of Energy (DoE).

The panel, led by Sol Buchsbaum, executive vice president with Bell Laboratories, says that over the next five to seven years the US should double its spending on magnetic fusion R&D—the DoE's budget for this for the year to October is \$355.6 million—and that engineering should now be the main priority.

To some certain extent this is an acknowledgement that, while the scientific feasibility of fusion reactors has not been proved, no new obstacles are likely to appear to make it impossible to tap the energy that powers the stars and the hydrogen bomb.

The report looks only at magnetic fusion machines. In these devices atomic nuclei combine, releasing energy in the process. To begin with, the fuels for fusion will probably be deuterium and tritium—two isotopes of hydrogen—although the report says that the US should investigate alternative fuel cycles. (A reactor fuelled solely by deuterium is the most likely, and most attractive, alternative.) Because the fusion fuels are very hot—they have to reach temperatures of around 100 million degrees



Princeton's Tokamak Fusion Test Reactor will cost \$300 million and will start to work next year. The \$1 billion FED could follow in 1990

in a reactor which means that they are fully ionised gases with the electrons and neutrons totally dissociated—they can be contained only by a magnetic field.

The most advanced type of magnetic container is the tokamak device invented in the USSR. The report says that the DoE should aim to build a large heat producing tokamak for around \$1 billion. This is considerably cheaper than the \$1.5 billion Engineering Test Facility (ETF) that is being designed by a DoE team at the Oak Ridge National Laboratory. The saving would come from building a machine that is not expected to be available for experiments for most of the time—in other words reliability is sacrificed to save money. To a large extent the DoE's pursuit of reliability stems from its plan to use ETF for a series of engineering investigations. For example, the DoE had hoped to test some of the materials that will be subjected to a constant bombardment of energetic neutrons in a reactor. This isn't possible in a machine that is out of action most of the time.

In other words, the Buchsbaum report suggests a less ambitious project. It makes similar recommendations for two other machines that use differently shaped magnetic containers—the Mirror Fusion Test Facility (MFTF), and the Elmo Bumpy Torus. The DoE should not go out of its way to speed up MFTF, and it could delay EBT a year, says Buchsbaum.

Just how influential the report will be remains to be seen, but some observers say that it has already had one effect. The day after the report was released, the House of Representatives voted to restore \$23 million that the House's appropriations committee had cut from the President's proposed budget of \$396 million for fusion in the coming fiscal

year. And unofficial reports suggest that the DoE could be given more than it has asked for in the next fiscal year, starting in October 1981.

In spite of its generally positive approach to fusion's future, the panel warns that we cannot be sure "that a safe, environmentally acceptable, economically attractive fusion reactor can be built and operated". For this reason the panel recommends continued emphasis on research in plasma physics and other basic fusion technology along with a flexible approach to reactor design.

The group clearly accepts the DoE's claim that building another large tokamak after the Princeton Tokamak Fusion Test Reactor would not commit it to building a tokamak power station. Most of the engineering development carried out on the \$1 billion tokamak will be useful even if this particular confinement geometry is rejected and replaced by one of the newer systems. However, the report warns that "the DoE should be highly discriminating in advancing existing alternate concepts much beyond their present scopes".

The report's suggestion that the DoE should embark on FED now would, if accepted, allow the department to start ordering parts for the device in 1984, after TFTR has been operating for three years. The DoE has to find a site for the new Center for Fusion Engineering as soon as possible. While the DoE wants a site without any existing fusion research so that it can assemble a new team to work on the project, it does not have to be a "green field" site: the DoE is already talking to NASA about the possibility of taking over one of the space agency's old establishments; the space programme is the victim of continuing budget cuts, leaving NASA with surplus "real estate". □

Observer



"Where else will we get such good publicity?"

This week

continued

Arab science runs into political trouble

The transfer of its headquarters from Cairo to Tunis has hobbled the work of the Arab League Educational Cultural and Scientific Organisation (ALECSO). The move was a result of the Arab League's boycott of Egypt following recent agreements between Egypt and Israel. President Anwar Sadat reacted to the move by freezing ALECSO's assets and withholding exit permits for Egyptian scientists who wanted to move with ALECSO to Tunis. While ALECSO has a new office building in Tunis, it has not been allowed to transfer any documents and has had to leave behind most of its scientific equipment and most of its scientists.

ALECSO is a major scientific organisation in the Middle East. It is now operating without an assistant director for science and only 32 of its 237 scientists have been able to move to Tunis. Most of ALECSO's consultants were also Egyptians and the organisation now has to find a score of new consultants. Moreover, ALECSO will have to adapt to working in Tunisia, a country where science and technology are conspicuous largely by their absence, after several years in the comparatively rich scientific environment of Egypt.

The move to Tunis has seriously hit ALECSO's publication and training programmes. *The Arab Science Abstract*, which ALECSO recently revived, has not appeared for almost a year and ALECSO has made no new additions to its highly praised series of science monographs. It has dropped many of the training courses it planned. Research relying on Egyptian expertise, especially in informatics and instrumentation, has halted until ALECSO replaces Egyptian scientists.

According to Mohammad Mahmoud ar-Rafaai, director of ALECSO's science section, it will take the organisation more than a year to make good the losses sustained in the move. Jordan is supplying many scientists to fill the gaps

left by Egyptians refused exit permits. And some regional science centres, such as the Centre for Scientific Apparatus, are being started anew in Amman, Jordan's capital. Many of ALECSO's conferences originally planned for Cairo will now take place in Amman.

Despite these problems, ALECSO continues to start new projects. For example, it has just launched a study of the environmental conditions in Palestinian refugee camps and, in cooperation with United Nations Environmental Programme (UNEP), a regional project to monitor desertification in North Africa. It has also prepared an Arab plan for harnessing renewable energy for a symposium on the subject

Despite problems created by ALECSO's move from Cairo to Tunis, the organisation is still starting new research projects—including one on desertification with the United Nations Environment Programme



Earthlink/Mark Edwards

Earth's schizophrenic magnetic field

Every so often, at intervals from 50 000 to one million years, the Earth's magnetic field flips over. The magnetic North Pole becomes magnetic South, and the South, North. Geophysical evidence strongly suggests that the last magnetic reversal happened about 700 000 years ago. But recent satellite data hint that the next reversal might come very shortly—perhaps 1200 years from now.

The suggestion comes from data gathered by Magsat, a small satellite that burned up in the atmosphere last

in Iraq next year.

Ar-Rafaai insists that ALECSO's more important studies have not suffered too much from the loss of Egyptian expertise. Its research on pollution in the Red Sea and Gulf of Aden has continued without serious disruption. Indeed, later this year littoral Arab states will sign a revised treaty on pollution in the Red Sea and Gulf of Aden (to take into account pollution from the excavation of Red Sea mud and radioactive wastes from nuclear-powered desalination plants). Another of ALECSO's major studies—on environmental considerations in industrialisation—is almost complete. ALECSO will present the conclusions of this study to a symposium on the transfer of technology which it plans to hold in Aden next year. □

month. Data from the satellite confirmed previous observations that the strength of Earth's magnetic field is slowly declining: the intensity is dropping, according to Magsat, at a rate of about 1 per cent per decade. If that decline continues at the same rate—a big if, according to geophysicists—the field should reverse in about 1200 years from now. However, other factors could precipitate an earlier or later change.

Quite what effects a reversal would have is an open question. Some theorists have linked reversals to mass extinctions of creatures such as dinosaurs, but there is no hard evidence of such cataclysms. □

More alarms at Three Mile Island

The venting of radioactive krypton-85 from the crippled reactor at Three Mile Island (TMI) began at 8 am last Saturday—but the krypton immediately set off radiation alarms and the venting was halted after only four minutes.

The purging of 57 000 curies of krypton from the containment building at TMI is an essential step in the \$400 million clean-up operation there. It involves drawing the krypton through two filters to trap radioactive particles, mixing the gas with fresh air and expelling the diluted krypton through a 50-metre high steel stack.

The gas passes two radiation monitors that measure its combined beta and gamma activity before being expelled into the atmosphere. As soon as the krypton reached the radiation monitors, alarms started buzzing in the control

room at TMI. Venting was then suspended for a day. At first, technicians thought that the alarms meant that the escaping gas contained unexpectedly high levels of particles emitting gamma radiation. Krypton emits less harmful beta rays. But the monitors show only aggregated beta and gamma radiation.

At a news conference on Saturday, Harold Denton, the Nuclear Regulatory Commission's director of reactor regulation, said that the problem with the alarms was not unexpected. It was, he said, "yet another glitch" in the long and controversial process of venting the krypton. Brian Fabian of Metropolitan Edison, which runs the TMI plant, told *New Scientist* that the krypton triggered the monitors because the alarms were set at a very low, conservative threshold. "The high level of krypton radia-

tion was apparently being misread as particulates," said Fabian. But, he said, analysis of the gas and the filters showed no particles contaminated by caesium or strontium passing through the filters.

Operators in the control room disconnected the alarms, but continued to log the digital readouts of radiation emitted with the krypton. The NRC approved of this move, but insisted that the operators sample for particulates every 15 minutes and stop the venting if radiation exceeded permissible levels. Fabian says that the levels of radiation emitted over the weekend were well within government standards. Over 40 monitoring stations have been set up within an 80 kilometre radius of the plant. None of them registered readings above the background levels of radiation during venting at the weekend. Nevertheless, an estimated 2000 people left the area to avoid any possible hazard. □

Shake-up in Syrian science imminent

Ziauddin Sardar

Syria has decided to reorganise radically its science and technology. For more than two decades, Syria has pursued a science policy unique in the Middle East. Other Arab states have backed industrialisation and the import of Western technology. But Syria has concentrated on agriculture and the "Arabisation of science".

In the past few years, however, Syria has diversified its research and development: a number of independent industrial research centres have emerged and the country is moving into Western technologies such as electronics, chemicals and nuclear energy. The superstructure of Syrian science under the Ministry of Education and the Ministry of Agriculture and Agrarian Reform, which has existed since the Baathist Revolution of March 1963, is crumbling under the impact of these trends.

Dr Zafar L. Sawaf, director of the Centre for Industrial Research and Development, says: "despite the fact that our research endeavours are very small compared to those in a developed country, they are isolated and fragmented. There is no horizontal communication between ministries and universities. Since 1973 we have felt that Syrian science has outgrown the present organisational structure."

Fragmentation and lack of direction in research are problems not unique to Syria. They plague most developing countries. But Syria's research activities are unusual: they are modest and often intensely local. According to Sawaf, "this is because the Syrian economy does not permit extravagant and ambitious ventures". And there is also a strong tradition in Syria of applied research based on local needs and resources. The work ethic of traditional craftsmen, still to be seen in the *souks* (markets) of Damascus and Aleppo, has permeated mainstream research.

Agriculture dominates the Syrian economy: it accounts for at least 25 per cent of the gross national product and employs two-thirds of the labour force. Cotton is the most important cash crop, supplying the large textile industries in Aleppo and Damascus.

It is not surprising that government-sponsored research has, up to now, concentrated almost exclusively on agriculture. Syria's main research organisation is the Agricultural Research Centre operated by the Ministry of Agriculture and Agrarian Reform. The centre has seven sections, which carry out most of Syria's agricultural research without much outside assistance.

The Ministry of Agriculture and Agrarian Reform also runs the Syrian Cotton Bureau in Aleppo. Established in 1952, the Cotton Bureau has 10 stations throughout the country.

Concentrating research on cotton has paid dividends. The area of irrigated land under cotton has grown to 200 000 hectares. The Cotton Bureau has per-



Christine Osbourne

Traditional craftsmanship in the souks of Syria has permeated modern research

fect the variety of cotton known as Aleppo 1, which produces high yields and is practically immune to the most prevalent disease of cotton. About 97 per cent of the cotton now grown in Syria is the Aleppo 1 variety; the remaining 3 per cent is the Aleppo 40 variety, also developed by the Cotton Bureau. The bureau is now trying to breed a "glandless" variety of Aleppo 1, which can be used as a raw material in the production of seed cakes for humans and animal feed. This plant protein will be a valuable contribution to Syria's food supplies.

Academic research too has concentrated on agriculture. The faculty of agriculture of the University of Aleppo was one of the first faculties to be established (in 1960). Scientists there are studying soil reclamation, fruit trees and field crops. The faculty is the centre for an international research programme on integrated pest control in cotton growing and is the headquarters of the Arab Plant Protection Society.

Syrian academic science has also concentrated on the Arabisation of science and the history of Islamic science. The University of Aleppo, for example, tried to teach and conduct postgraduate research in Arabic. However, the university soon realised that research would be seriously hampered if it did not organise postgraduate courses taught in English or French. The less a student knows of foreign languages, the narrower his field of research; very few works of reference or research papers in Arabic are avail-

able to him.

Nevertheless, the University of Damascus continues to teach all postgraduate science courses in Arabic—the only university in the world to do so. The university's commitment to teaching in Arabic undoubtedly hindered the development of independent research there. But the university saw teaching in Arabic as a pre-requisite for indigenous research.

The Syrian science community draws deep inspiration from its history. It is no accident that the most famous research institution in Syria is the Institute for the History of Arabic Science at the University of Aleppo. This is a showpiece of Syrian science. It was established in 1976 by a special presidential decree and is the only institute in the Middle East for postgraduate research on the history of Arab science.

While Syrian scientists are increasingly aware of the rich history of science in their country, they have also worked in the past five years to extend the scope of their research. The faculty of engineering at the University of Aleppo, for example, has recently established laboratories for the study of industrial hydraulics, aerodynamics, refrigeration and air-conditioning, water analysis, and automatic control. The University of Damascus is also investing in research laboratories, and there are plans to extend the science and engineering faculties there.

The government has set up three new research centres, all in Damascus. The Centre for Scientific Studies and Research is concerned with electronics, industrial management and operational research. The Centre for Industrial Research and Development studies the industrial potential of local goods and processes. The third centre, not fully operational year, will be the Centre for Nuclear Energy and Research.

In view of these developments, the government is exploring three ways of reorganising science. One idea is to set up a Ministry of Science to coordinate scientific research in government organisations and to fund other research. However, some Syrian scientists argue that this scheme is impractical because it proposes one organisation to coordinate scientific activities and another—namely the Ministry of Planning—for science policy. They suggest a Science Council, independent of the Ministry of Higher Education and responsible to the prime minister to coordinate research and development and to elaborate science policy.

The third choice—which seems to have the support of the most scientists—is to create a Ministry of Science and to set up a high-ranking Science Council to give Syrian science much-needed direction. The Science Council would work closely with the Ministry of Planning and would be responsible for developing science policy. □

Thisweek

continued

Triplets in the sky

Astronomers in Arizona recently received quite a surprise when they examined three images close together on their telescope's TV monitor. And their observations could cast doubt on the calculations behind current estimates of the age and size of the Universe. But the observations do confirm one of the stranger consequences of Einstein's theory of general relativity—that concentrations of mass can literally bend rays of light.

Ray Weymann leads a group at the Steward Observatory in Arizona that is currently making a survey of quasars—star-like objects that radiate strongly at particular points in the light spectrum. These peaks are moved from their normal position (red-shifted) by an amount that indicates how fast the quasars are travelling away from us. A close look at the quasar designated PG 1115 + 08 showed Weymann that it had two fainter neighbours.

Weymann's team examined the spectra of the two new sources, expecting to find two emission patterns totally different from each other and from that of PG 1115 + 08—a quasar's spectrum is like a fingerprint: no two are exactly alike. But the researchers were surprised to find that the spectra of light from both companions exactly matched that of PG 1115 + 08. The three patches of light

they saw on their TV monitors were, in fact, three separate images of the same source. Some unseen effect along the path taken by light from the quasar must be splitting the beam.

Astronomers predicted that this might happen some 10 years ago. The effect is a consequence of Einstein's theory of general relativity, which says that photons—quantum bundles of light—are not totally weightless, as they normally appear to us. In the vicinity of an extremely massive and compact object, gravitational forces suck the light inwards, just as apples fall off trees towards the centre of the Earth. So a massive object must lie between PG 1115 + 08 and Earth, acting as a gravitational lens and causing the extra images.

This is not the first time Weymann has seen double in the sky. Last May he was part of an international team that found the first double quasar—0957 + 56. Observers have now identified the "lens" distorting light from 0957 + 56

—a galaxy too far away to be named.

According to Professor Alek Boksenberg of University College, London, about 1 per cent of quasars should appear to observers as multiple images. As there are only 1500 or so known quasars, this doesn't leave very many multiple images to find. But Boksenberg thinks that astronomers searching for quasars on their photographic plates will now be more careful to check that faint neighbours of quasars are not, in fact, separate images of the same source.

Quasars are an important guide to astronomers: they reveal the characteristics of very distant regions in space. The brightness of a small number of quasars—the nearest and the furthest—are crucial parameters in calculating the size and age of the Universe. Boksenberg points out that if astronomers are observing multiple images of these quasars, the brightness values they measure will be artificially inflated. It might be prudent for the cosmologists to check that they haven't been seeing double without knowing it! □

India cracks open US non-proliferation front

WASHINGTON DC—With the help of President Carter, India has trumped its opponents in Washington DC and laid claim to over 39 000 kilograms of uranium for its Tarapur atomic power station. Overruling the Nuclear Regulatory Commission, which refused to grant a licence for the export of uranium to India, President Carter said the "key south Asian democracy" must get the goods. But India may still not collect. Congress is already threatening to play its own ace card: it has the power to override Carter's order and stop the shipment.

Proponents of an air-tight Nuclear Non-proliferation Act have been the most outspoken critics of the uranium shipment (which would be accompanied by replacement parts for the nuclear power station). Former astronaut and Democratic Senator John Glenn of Ohio rallied congressional opponents against Carter, stating that the White House order "puts the final stake through the heart" of the US's non-proliferation policy. In the House of Representatives,

23 members of the key foreign affairs committee, a sizeable majority, promised to vote Carter down.

India's transgressions—in the eyes of US politicians—include its refusal to accept the full international safeguards, such as full inspection of nuclear plants, on its peaceful nuclear activities. Neither has the Indian government promised to discontinue further tests of nuclear weapons. India used Canadian-supplied uranium to build a nuclear device which it exploded in 1974.

Carter argues that the export of uranium will help "maintain a dialogue with India in which we try to narrow our differences on these issues". But many in Congress fear that exporting uranium to India will wedge open the US's non-proliferation policy and others will flood the country with requests for nuclear materials. However, observers in Washington note that the view of India from the White House looks rosier every day that Russia's aggression in Afghanistan and Iranian intransigence continue. □

Mount St Helens spoils atmospheric research

NEW YORK—The eruptions of Mount St Helens are likely to claim yet another victim: scientific research on the atmosphere. According to Kirby Hanson of the US National Oceanic and Atmospheric Administration, dust from the volcano in Washington State is likely to confuse urgent attempts to measure the effect of burning fossil fuels on climate.

Some scientists fear that the carbon dioxide emitted into the atmosphere when fossil fuels burn is slowly warming up the atmosphere—through the "greenhouse" effect. Measurements so far have been ambiguous, but researchers had hoped to settle the issue by monitoring atmospheric temperatures over the next few years.

But the debris blasted into the atmosphere by Mount St Helens seems likely to throw out all the calculations. "There is strong evidence from earlier large volcanic eruptions that particles and gases from these eruptions entered the stratosphere and, after spreading over much of the Earth, caused slight cooling of the air near the Earth's surface, and warming of the stratosphere," explained Hanson. If the dust from Mount St Helens reaches high enough into the stratosphere, the cooling that it will cause will almost certainly mask any increases in temperature attributable to carbon dioxide. "This would likely rule out early detection of carbon dioxide-induced temperature changes." □

India's nuclear future looks rosier now that President Carter has overruled the US Nuclear Regulatory Commission and decided to allow the export of uranium fuel to the "key south Asian democracy" to go ahead. But the US Congress has the power to stop the export of uranium and could still exercise its prerogative



Camera Press

The human cost of Love Canal

Janet Raloff

Half the pregnancies in the 1960s among women living on 99th Street bordering the toxic chemical dump at Love Canal in Niagara Falls, New York State, ended in miscarriage, according to a report issued last week by the state's Health Department. The publication of this report is the first time the state has released details of three separate studies it performed in 1978.

The studies, involving 2600 women, covered the 27 years after 1949. According to the report, 10 of the 20 pregnant women living along 99th Street, between 1958 and 1964, miscarried. The rate of miscarriage doctors consider normal is 15 per cent. The state's survey also found elevated rates of miscarriages and birth defects in other regions near Love Canal, but the rate was highest along 99th Street. Since the early 1960s, the miscarriage rate has dropped nearly to normal, the state's researchers say.

This is but one of several reports documenting an unusually high incidence of disease among people living near Love Canal. Most have proved controversial.

For example, *The New York Times* last week claimed that the prestigious journal *Science* rejected a report of New York State's research into miscarriages as statistically unsound. And a preliminary study for the Environmental Protection Agency (EPA) by the Biogenics Corporation—which found an abnormally high rate of chromosome abnormalities in people living near Love Canal—was blasted last month by two different government review panels. Both panels said that the design of the study was faulty and that its results were inconclusive.

But a more recent review, by three university researchers, says that there are no fundamental deficiencies in the study. One of the three reviewers was Jack Kilian, professor of occupational medicine at the University of Texas's Health Science Center. Kilian had worked with Dante Picciano, the main author of Biogenics's report, on a previous controversial chromosome study.

Following the studies in 1978 that confirmed the hazards of the dump at Love Canal, the state eventually bought the homes of the 239 families living nearest the dump (mainly on 99th Street). The problem the state and federal governments faced after the release of Biogenics's more recent study was what to do about 710 families living slightly further away from the dump. Biogenics's study suggests that these families too may be at risk.

The federal and state government offered to help the 710 families to move out of the area for a limited period—six months. But now the scientific community is apparently vacillating about the validity of Biogenics's study. This vacillation is putting an enormous stress on the residents of Love Canal. What good is moving, they ask, if it's only for

six months? And if the new studies the federal and state authorities want to carry out suggest that the evacuation should become permanent, who will compensate the 710 working-class families for the loss of their homes?

Only 499 of the 710 families that qualify for federal aid have in fact taken up the offer. "Many of those who haven't left desperately want to," Lois Gibbs, president of the Love Canal Homeowners Association, told *New Scientist*. "But they feel they cannot because of vandalism and arson in the neighbourhood." Gibbs also pointed out that if families leave, they will invalidate the insurance policies on their homes and on their possessions.

Temporary evacuation is costing the government \$1.3 million a month. The government limited its offer of financial help to six months because it thought that better-designed studies could confirm or deny the health hazards suggested by Biogenics's study in that time. But now the families concerned have boycotted these studies because not all the 710 families will be included in them.

Meanwhile, it is becoming apparent that Love Canal is only one problem among many. Senator Edward Kennedy recently announced that as many as 1.6 million Americans could be exposed to serious health hazards from dumps for toxic wastes, according to the EPA's figures. Love Canal is but the first disaster to surface. The EPA says that there may be as many as 30 000 dumps in the US holding toxic wastes. But so far the agency has identified only 645. Of



Niagara Gazette

The stress of living on Love Canal

these, 108 pose serious hazards to human health and the environment.

Faced with a potential disaster of enormous dimensions, the EPA last week asked President Carter for more money to survey the health of people living near Love Canal. And rumours are flying that the Carter administration is drawing up plans for a new panel, with members from several government agencies, to handle disasters such as Love Canal. □

Sweeping changes in government research

The Department of the Environment is to dismantle its Research Directorate—a unit with 79 staff and a budget last year of £31.9 million. And the Department of Transport is also making sweeping changes in the organisation of its research, creating a new research supremo.

The changes at the Department of the Environment (DoE) are being made to cut spending. The dismantling of the Research Directorate means a complete decentralisation of research within the department. The DoE has a dozen main directorates dealing with ancient monuments, environmental protection, legal services, and so on. These directorates will now be responsible for their own research: they will have to use their own resources to define research they need, secure ministerial permission to finance the work, and supervise research in progress.

The scientific resources of the directorates will be strengthened but there is no guarantee that they will be able to cope, or that jobs will be found for the staff of the dismantled Research Directorate. Martin Holdgate, Director General of the Research Directorate, will become now the DoE's Chief Scientist

and will keep a small policy unit to keep an eye on scientific developments and to advise the department's main directorates. Holdgate will also continue to serve the Department of Transport (DoT) as Chief Scientist.

The DoT, meanwhile, has seized on the opportunity presented by the imminent retirement of Alec Silverleaf, the director of the department's Transport and Road Research Laboratory (TRL), to reorganise its research. Silverleaf's successor as director of the TRL will also be responsible for the DoT's "in-house" research. He will have a total budget of £22 million.

The holder of the new post—called the Controller of Research and Development and the TRRL—will report to Holdgate. The name most frequently mentioned as a candidate for the post is the DoT's chief highway engineer, Ron Bridle. However, the embarrassing failure of the £7 million Regional Highway Traffic Model, which was financed from the chief highway engineer's budget, may count against Bridle, especially since the damning report of the independent Leitch Committee on the model will be published soon. □

This week

continued

Brian Lee in Adelaide reports from this year's congress of the Australia and New Zealand Association for the Advancement of Science

Antipodean antics in Adelaide

Billed as the best ANZAAS Congress ever, the recent 50th anniversary conference of the Australia and New Zealand Association for the Advancement of Science (ANZAAS) began more with a whimper than a bang. From the start it was obvious that the long-promised array of star scientists from other countries had failed to materialise, and a distressing lack of attention to organisational details threatened to bring confusion to the campus of the University of Adelaide—the site of this year's congress.

In Adelaide they do things differently. The city prides itself on its cultural activities. But when Christopher Hunt, the British-born director of this year's very successful Adelaide Festival of Arts, stated too many home truths, the city sacked him—an event that led a local sculptor to scandalise fellow citizens by displaying a sculpture of Hunt crucified on a hill of bare establishment backside.

Nevertheless, the Adelaide congress was probably a success as a talking shop

for scientists—even though the organising committee of the economics section of ANZAAS was so disillusioned by the whole performance that it circulated a two-page list of complaints, capped with a threat to withdraw from ANZAAS.

But for an association that claims to bring science to the people, this year's effort ranked as appalling. A few brave members of the general public did venture in, but one wonders how they fared. Facilities for reporters were chaotic. As it happened, that didn't matter much—on the third day of the congress, the nation's newspaper journalists went on strike against visual display terminals.

It is time for ANZAAS to sit down and consider its future. No doubt it does 3000 specialist scientists good to find out what their colleagues in other disciplines are doing. But when it comes to carrying the message to the public, ANZAAS verges on moribund. Whoever heard of the entire film programme of a congress like this being cancelled at the last minute for lack of a place to screen the films? □



Reflections in Adelaide

Australia's weather confirms the greenhouse effect

The world really does seem to be warming up because of the "greenhouse" effect caused by the ever increasing amounts of carbon dioxide given off when fossil fuels burn. That is perhaps pitching it a big strong, but the preliminary results of some Australian research announced at ANZAAS are hardly reassuring.

Scientists expect a doubling of carbon dioxide levels in the atmosphere in the next 100 years or so. Their climatic models predict that this doubling will warm the Earth's surface by about 3°C, with an increase of something like 2°C at the Equator, and 8°C at the poles.

Dr Brian Tucker, from the Atmospheric Physics Division of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), suggested that atmospheric models can be verified only by actually observing the changes they predict. Atmospheric carbon dioxide levels have increased by about 10 per cent in the past 30 years. Such an increase should, the experts say, warm up the Earth's surface by about 0.3°C—a change too small to detect. Changes in rainfall are also too small to detect above the background "noise" of seasonal variations.

Undaunted, Tucker and his colleagues recently tried fitting Australian meteorological information to the very crude predictions of the most recent climatic model, which forecasts that increases in the temperature of the Earth's surface should have been largest in the southern part of Australia, while rainfall increases should have been largest in the north and in the centre of the continent.

Moreover, the largest of these increases should be large enough to detect.

Tucker and his colleagues analysed statistics from several meteorological stations in South Australia and examined the Bureau of Meteorology's rainfall statistics. Four of the eight meteorological stations in South Australia indicated annual increases in the minimum daily mean temperature that averaged about 0.8°C. As predicted, rainfall data for the same stations showed no significant trends. Their analysis of the bureau's statistics on rainfall revealed increases that could be interpreted as being consistent with the model only in the north-western part of the continent.

Tucker points out that these results should not be taken too seriously. But they may possibly represent the first observations confirming researchers' predictions about the long-term effects of increasing carbon dioxide levels in the atmosphere.

However, another paper presented in the same symposium at ANZAAS demonstrated the dangers of setting too much store by predictions of the effects of increasing carbon dioxide levels. Dr Keith Bigg of the CSIRO's Cloud Physics Division has been comparing particles in the atmosphere at Australia's sampling station in north-western Tasmania with those found at the American stations at Mauna Loa (Hawaii), Barrow (Alaska), and at the South Pole. Large numbers of these particles in the atmosphere, many of which come from industrial pollution, may well cool down the Earth by blocking sunlight.

The air in Antarctica and in north-western Tasmania is generally very clean, according to Bigg's survey. But, he said, Arctic air is "quite dirty", containing many solid particles liberally coated with sulphuric acid—particles typical of urban pollution.

Atmospheric particles are a matter for concern because they affect the formation of clouds. Water droplets form on the particles, so more particles mean more water droplets in the clouds. This increase in the number of droplets has two effects: it reduces rainfall because individual droplets will be smaller and therefore less likely to turn into raindrops; and it makes the clouds reflect more sunlight back into space. So, Bigg warned, any human activity that changes the cloud cover could seriously upset the Earth's radiation balance. □

Best of all worlds

Dr Rupert J. Best, the chairman of the committee that organised this year's ANZAAS congress, loomed large in the congress programme. On page 5 appeared "The Introduction"—written by Rupert J. Best. He then reappeared on pages 8, 9, 10 and 12 in his respective capacities as chairman of the South Australian ANZAAS Division, congress chairman, finance committee chairman, the butt of some esoteric verses about an ANZAAS Jubilee Fanfare, and as author of a brief historical sketch of ANZAAS. Then on page 16 appeared a list of three exhibitions—a trade exhibition, one on the history of ANZAAS in South Australia from 1888 to 1980—collected and arranged by Rupert J. Best, and a display of handmade stoneware pottery by —wait for it—Rupert J. Best. □

ANZAAS

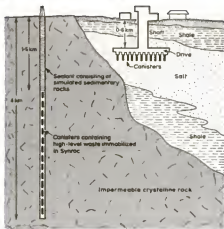
Synroc: key to nuclear non-proliferation

As elsewhere, the chasm at the ANZAAS congress between the advocates of Australia using its huge deposits of uranium and those who oppose uranium mining remains as wide as ever. In the long run, perhaps a paper presented by Professor Ted Ringwood of the Australian National University in Canberra will do more than all the ballyhoo to crystallise thinking on the matter.

Ringwood invented Synroc, a material for entombing radioactive nuclear waste. (European governments currently favour an alternative to Synroc—borosilicate glass.) Ringwood dismissed the ostrich-like tendency of Australian anti-nuclear groups to assume that Australia will reduce the risks of nuclear proliferation by keeping her uranium in the ground. He pointed out that there are major new finds of the mineral in Africa, Brazil and Canada, making Australia's decisions about her uranium largely irrelevant to the proliferation argument.

Ringwood suggested that Australia could responsibly provide uranium to other nations, yet at the same time prevent its uranium being used in nuclear weapons. His own Synroc process is central to his thinking. He sees the problem of waste disposal as the crux of the proliferation debate. Last year, the US Nuclear Regulatory Commission and the US National Academy of Sciences independently concluded that disposing of nuclear wastes by incorporating them in borosilicate glass is not a satisfactory solution to the problems wastes create.

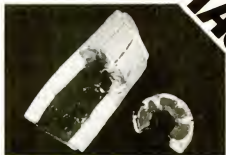
Borosilicate glasses disintegrate on contact with underground waters at quite moderate temperatures and pressures, Ringwood claimed. And, he said,



it is very difficult to find places to bury "glassified" waste where geologists can guarantee that groundwater will not get to the waste. With Synroc, Ringwood claims, this problem does not arise.

In the Synroc process the radioactive wastes are trapped in the crystal lattices of the minerals of the synthetic rocks and so are completely immobilised. Ringwood pointed out that natural materials structurally very similar to Synroc have survived for as long as 2000 million years in geological conditions far more extreme than would be encountered in any geological repository for nuclear waste. Moreover, some of these natural materials have suffered far more radiation damage than would any nuclear waste, without any significant loss of radioactive elements.

Ringwood thinks that this immobilisation of radioactive wastes in Synroc will,



Ringwood's idea of a geological repository for nuclear waste (far left) and the currently favoured scheme (left) for burying canisters of waste embedded in borosilicate glass, which can break up at moderate temperatures and pressures (above)

in itself, guarantee their safe disposal. But he also wants wastes to be buried in geologically safe locations as an extra guarantee that wastes will not leak. However, he sees the currently favoured method of burying radioactive wastes—in large, centralised, mined repositories between 500 and 700 metres deep—as a mistake. He proposes an alternative: putting small amounts of waste already immobilised in Synroc in drill holes.

Ringwood argued at ANZAAS that Australia should mine uranium and manufacture fuel rods for nuclear reactors itself. It should not sell these rods to other countries, merely lease them. When exhausted, the rods would be reprocessed and radioactive wastes, embedded in Synroc, would be buried in deep bore holes widely dispersed over the entire continent. □

Is DNA really a double helix?

Here's a heretical thought: is the famous double helix the only configuration that DNA molecules assume—indeed does the double helix really exist at all? Almost 30 years after James Watson and Francis Crick's *Nature* paper revealing their discovery of the double helix, this beautiful structure has come under sustained attack.

Seven years ago, Dr G. A. Rodley of New Zealand's University of Canterbury began to question accepted ideas about the structure of the DNA molecule. He was not satisfied by conventional explanations of how the double helix unwinds so that the genetic code embodied in its DNA can be read. Eventually, he came up with a structure like a zip—in which the nucleotide strands of the DNA lie side by side. In his model, the strands are alternating left- and right-handed helices (each with five base pairs) with a "long-distance" right-handed twist superimposed on the helices.

Rodley's structure circumvents the "unwinding problem"—when the genetic code is read, the two strands merely have to "unzip" and then return to their original position.

In his model the bases pair just as they do in Watson and Crick's double helix—indeed the distances between the nucleotide strands and the pairs of bases are the same in the two models.

At Rodley's request, Professor R. H. T. Bates of the University of Canterbury's Electrical Engineering Department checked whether Rodley's side-by-side structure was compatible with the data gathered by X-ray diffraction of DNA (mostly 20 years ago). Bates found that Rodley's model would fit the data. Indeed, it soon became apparent that a whole family of structures may well be compatible with the now famous X-ray diffraction patterns that DNA produces.

After studying more recent data and re-examining the older diffraction patterns, the New Zealanders concluded that the side-by-side model actually fits the data more closely than the double helix—although they admit that the resolution of X-ray diffraction patterns is so rough that this superiority may not mean much.

There seems to be no way of settling the argument with current X-ray diffraction techniques—the patterns they pro-

DNA is really two helices side by side (far right), not the famous double helix (right), say New Zealanders G. A. Rodley and R. H. T. Bates



duce are just too crude. However, Rodley's model strongly suggests that right-handed helices can exist: scientists had previously thought all DNA helices were left-handed.

And what does Francis Crick think of all this? Bates says that Crick still backs the double helix, but has been magnanimous enough to acknowledge the force of the New Zealanders' argument that the crucial X-ray patterns, on which the proof of the structure of DNA is based, are crude. □

This week

continued

US aircraft safety watchdog is incompetent

NEW YORK—The Federal Aviation Administration—the arm of the US government responsible for overseeing the safety of aircraft—is not technically competent enough to carry out its task. The FAA lacks the initiative to establish valid safety standards, and it tends to wait for accidents to happen before developing the types of regulations that might have prevented them. Such are the devastating conclusions of a panel of the National Research Council that investigated the FAA at the request of the Carter administration, following the crash of an American Airlines DC-10 in May last year at Chicago that killed 273 people.

The panel, put together by the National Academy of Sciences, issued its verdict on the FAA last week—and its conclusions were the most critical that the FAA has yet heard. The panel recommends: a rule that airlines should be designed in such a way that severe structural failures will not necessarily cause fatal crashes; a centrally organised group of engineers in the FAA to licence the design, production and maintenance of planes; and an independent advisory board to be appointed by the Secretary

of Transportation, the ultimate boss of the FAA. The recommendation on improvements in design is intended to ensure that the DC-10 crash will not be repeated. The crash occurred after an engine assembly damaged by incorrect maintenance procedures fell off the plane, taking with it critical hydraulic and electrical lines. The panel's suggestion of a central organisation of engineers in the FAA is designed to overcome the admitted thinness of engineering expertise in the agency's regional offices, which currently certify aircraft.

Indeed, the weakness of technical staff is the main problem that the FAA faces, according to the panel. "The committee finds that the technical competence and up-to-date knowledge required of people in the FAA have fallen behind those in industry," the report states. "As aircraft become more sophisticated, costly, and numerous, and as the generation of government engineers and inspectors who gained broad knowledge as the industry was developing begins to retire, the FAA staff face fewer challenges and reduced expectations." Panel chairman George Low, a former executive with NASA



Chicago DC-10 crash

who is now president of the Rensselaer Polytechnic Institute, put the conclusion more succinctly: "The FAA engineering staff today is considerably less competent than the engineering they regulate."

Just what action the report will provoke remains to be seen. Some cynical observers in Washington suggest that it will be discreetly lost in the coming months. □

Chemicals cause new wave of cancers

The incidence of cancer among Americans is rising for the first time in 30 years, says a study by the prestigious Council on Environmental Quality, published this week. Moreover, Gus Speth, chairman of the council (which advises the president) and head of the government Toxic Substances Strategy Committee, which published the report, said: "We estimate that occupational exposure to carcinogens is a factor in more than 20 per cent of all cancers." Speth pointed out that after adjusting for age and increasing longevity (the population is longer lived today than in 1970) the incidence of cancer "increased by about 10 per cent between 1970 and 1976." "This does suggest some new causal factor," Speth said. "We don't know if toxic chemicals played a role... But it is a matter of great concern to us."

The study compared various cancers linked with occupational hazards—lung (corrected for the risks of smoking), liver, kidney, bladder cancer and mel-

noma (skin cancer) with those cancers traditionally associated with diet—colon, stomach, rectum, and pancreas. The first group's incidence increased at a rate of 4 per cent over the six year period, while the "dietary" group of cancers rose at a lower rate—only 1 per cent per year.

Robert Harris, a member of the council, said that it was difficult to separate the impact of the environment, hormones and life style on cancer rates from the impact of hazards in the work place. And he agreed with critics of the study—which include the industry-sponsored American Industrial Health Council—that the results are "preliminary" and "inconclusive" for a number of other reasons. The data was mainly drawn from two surveys, covering 12 different geographical areas, only four of which overlapped. The sample populations of both studies were not selected randomly so the results cannot be extrapolated to the country at large. The people were not closely matched either in life style and

environment or in levels of exposure to occupational hazards.

Why carry out these studies at all when the available evidence shows that industrial chemicals—such as pesticides and acrylonitrile—can cause cancer? Robert Harris says: "I don't think there's any point in doing many more studies. There is ample evidence to warrant taking rapid steps to reducing worker exposure to these chemicals." □

THE NEW SCIENTIST

20 years ago

The picturesque derricks associated in most people's minds with oilfields may one day be superseded by squat, compact hydraulic lifting machines. At last week's Exploration and Production Symposium at the Institute of Petroleum, Mr Hew Fanshawe explained how his fully automatic drilling outfit worked. The invention is supported by the National Research Development Corporation, and design has reached a stage where a full-scale prototype can be built. *The New Scientist*, 30 June, 1960

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**HEWLETT
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Microbes at work—is the price too high?

Biotechnology promises to change the face of industry, producing fuels, drugs and chemicals in a pollution-free world. But though Britain pioneered many of the key advances, we seem unable, yet again, to exploit our advantage . . .

Stephanie Yanchinski What is biotechnology and why are firms such as the food and detergent giant, Unilever, proclaiming that its impact will equal that of the microchip? The grand dream is to transform plant or animal cells, but especially microorganisms, into manufacturing powerhouses to produce industrial chemicals and drugs, while preserving scarce petroleum. Less exotic schemes make use of the catholic eating habits of bacteria to put them to work scavenging domestic and industrial wastes while heat exchangers trap the vast and endlessly renewable quantities of energy that they release. New foods, fertilisers, factories and fuels—these are the promises of biotechnology and all within a new conserving, non-polluting way of life. No wonder enthusiasts believe the 21st century will not be atomic, nor electronic, but bionic.

Man has practised "biotechnology" since he first discovered leavened bread and the pleasures of yeasty liquids to go with it. Until now, it was the process engineers who plodded on to make the unspectacular but substantial developments in fermentation technology that now earn millions for their companies. Their achievements went largely unsung.

This Cinderella technology is set to be revolutionised by genetic engineering. By tinkering with the coiled strands of genetic material—the chromosomes—of such common bacteria as *Escherichia coli* in such a way that "foreign" genes are incorporated into it, these bugs will manufacture substances alien to their normal growth and metabolism. Plant and animal cells can be tampered with in a similar way. These transformed biological agents could replace the traditional methods of manufacturing therapeutic drugs and vaccines, and industrial enzymes and chemicals.

This technique opens the door to making other, much more complicated compounds such as human growth hormone, insulin, and interferon in large enough quantities to be used therapeutically. Bugs available now will destroy persistent pesticides such as dieldrin in agricultural sewage and tolerate such high quantities of toxic metals that they can be used to trap copper and silver from mine tips and industrial wastes.

During the past two decades Britain led in biotechnology research. However, a report published recently says Britain is falling behind. It recommends much more money be spent on such research but has already been criticised as asking for "too little, too late". Biotechnology is the work of a prestigious joint working party chaired by Sir Alfred Spinks, former director of research at ICI, and including the Advisory Council for Applied Research and Development, the Advisory Board for the Research Councils and the Royal Society—bodies concerned with fashioning Britain's science policy.

The report's overriding message is that Britain is missing yet another opportunity to exploit new technology pioneered by its own scientists. It aims to winkle out ideas of solid commercial value, now languishing on university shelves, by encouraging the entrepreneurs among British scientists in universities, research institutes and technical colleges with financial rewards and facilities. As Alfred Spinks commented at a press briefing the day the report

was published, there is no large financial "flywheel" pushing the biotechnology revolution in Britain. Consequently, the report was published to state the very strong case for large private and public investment.

The Spinks report recommends spending around £7 million each year over the next five years on biotechnology, £2 million for a new biotechnology firm like the American Genentech. (For comparison, Cetus, the biotechnology firm based in California, spends at least \$55 million on R&D.) The research councils should spend at least £3 million annually; government research establishments, universities and research associations, about £2.5 million. At least 20 new teaching and research posts should be created over the next five years with a capital investment of around £2 million to provide adequate laboratory facilities. (John Ashworth, chief science adviser in the Cabinet Office, predicts 50 000 undergraduates will be needed to fill Britain's manpower needs.) Key areas that the group believes should receive immediate attention include genetic manipulation, enzymes and enzyme systems, monoclonal antibodies, waste treatment, plant cell culture, single cell protein and production of fuels from biomass. The report stresses that if Britain is to compete effectively on the world market research should not be hindered by too-strict safety guidelines.

Lack of venture capital is not the only reason Britain may fall behind. For example, the report mentions the failure of the "customer/contractor" principle that governs British research policy to fund biotechnology adequately,

and Britain's failure to provide adequate postgraduate training. There are no mechanisms to funnel back the immense profits to be made from such research to the workers, and an unadventurous and timid industrial

At least 20 new teaching and research posts should be created over the next five years with a capital investment of around £2 million . . . if Britain is to compete, research should not be hindered by too strict safety guidelines

spirit in Britain leaves researchers without alternative sources of cash. The City financiers have refused to get involved, unlike their West German counterparts who have offered to support a proposed EEC programme announced several months ago. (In the past few weeks, however, the Prudential Assurance company has committed £20 million to R&D, including biotechnology.) As a few case histories will reveal, strong government interference in funding research has discouraged the kind of entrepreneurial interchange between universities and industry that is fostered in the United States or West Germany.

The customer/contractor principle has governed British research policy since 1973. The idea, proposed in the Rothschild report, was to make research more relevant to Britain's immediate needs by focusing on certain strategic areas, pinpointed and paid for by "customers"—government departments, the research councils, and to a lesser extent industry. The "contractors" who do the research are government research units and universities. Biotechnology cannot fit easily into this neat scheme because one project, for example energy from biomass, cuts across many disciplines and many government departments. So there arises the usual territorial disputes over who is going to fund the research and in which institute.

The fundamental problem, never solved by the Rothschild report, is how suitably to reward universities for the long-term basic research and expensive training of highly

qualified experts in molecular biology, and biochemical engineering. A way must be found to share the fruits of the research councils' investments in biotechnology, claim scientists such as Sydney Brenner, head of the Medical Research Council's molecular biology unit at Cambridge. The way the National Research Development Corporation handles scientific patents illustrates this particular pitfall of British science policy.

Filing and protecting a patent is too expensive for inventors acting independently. To help researchers employed by government-funded organisations, including universities, they are required to file patents with the NRDC, whose time-consuming bureaucracy, lack of imagination, and rigid screening procedure mean many good ideas go begging. Some prestigious universities, such as Oxford, can negotiate a proportional sharing, usually 60:40, of the royalties accruing from the patents that are accepted, but MRC units such as Brenner's receive no royalties. The NRDC funnels these funds into a general pot for the research councils, and scientists draw on these in the usual way, by submitting projects. This means that the scientists whose patents earned the royalties would, even if their projects were approved, have to wait some time to reap the benefits of their work.

Moreover, many biologists feel their projects are not viewed favourably by a Science Research Council biased towards high energy physics, engineering and space

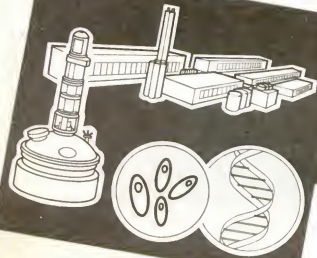
science. Professor S. Pirt, whose unit at Queen Elizabeth College recently won a prestigious BP energy research prize, said in a recent letter to *The Times* that the SRC's "token response" to the Spink's report "calls for questioning of the SRC's priorities". To illustrate his case, he points out that the SRC five years ago spent the equivalent of the total SRC budget for biotechnology (which he estimates to be about £700 000) on a preliminary study of a new radiotelescope which, in the end, merely proved that Britain could not afford to add yet another one to the battery already existing at Jodrell Bank.

Then there is the much publicised timidity of British industry. Watman, set up in 1968 by the NRDC to manufacture enzymes, was the first British firm in the field. Enzymes are biological catalysts and are widely used in industry. By 1974, the company had garnered enough capital to expand from bulk manufacturing to making kits for medical diagnosis, the real money-earners. They did not do so, although, one scientist who was on the Watman board points out, there appears to be no reason why. Tony Atkinson, head of the diagnostic reagent laboratory at the Centre for Applied Microbiological Research, Porton Down, says that although CAMR (as the Microbiological Research Establishment) pioneered the development of these enzymes, CAMR is selling licences for the bacillus strains and processes to the German pharmaceutical firm Boehringer among others. Selling such licences



Biotechnology

Report of a Joint Working Party



Advisory Council for Applied Research
Advisory Board



Traditionally, biotechnology has gone one way (into the craft industries of brewing and baking) while the chemical industry has gone another. Now it's clear that bacteria can be made to produce anything—that many of the great factories could become obsolete. But Britain is lagging behind according to the Spinks Committee report *Biotechnology*

barely covers development costs of these processes. Now CAMR has another potentially big money earner on its shelf—the bacterial assay for paracetamol awaits some eager investor. This is a five minute test which could replace the lengthy blood tests currently used on overdose victims who desperately need immediate diagnosis and attention.

The story of monoclonal antibodies reveals the other side of the coin: the case of very clever scientists who watched a big commercial opportunity slip by. Antibodies are proteins produced in small amounts by the body to attack a foreign invader and they are very specific. Antibodies begin their attack by sticking to particular molecular configurations—"antigens"—on the surface of the invaders. If a way could be found to produce antibodies on a commercial scale, then their specific attraction for one antigen could be exploited—as reagents to assay hormones and drugs, and as an early detector of disease. Antibodies could do this by picking up changes in levels of certain proteins within the body, which occur only during tissue destruction.

Sydney Brenner's Cambridge unit pioneered a technique for manufacturing antibodies in commercial quantities. They use cells from a specific type of human cancer, myeloma, as the antibody manufacturing powerhouse; this cancer grows in the spleen, which is one of the major sources of antibody in hearty people. Brenner's group inject animals with a range of antigens, so that a wide variety of antibodies are produced in the animal's cells. By fusing one of these cells with one of the cancer cells the Cambridge scientists eventually have a single myeloma cell which when divided—cloned—yields very pure, specific antibodies in large quantities. These are "monoclonal antibodies".

Any cell can be identified by its corresponding antibody, and in this way monoclonal antibodies can be used for blood and tissue typing (for organ transplants), to identify bacteria and viruses, and for picking up insulin and human growth hormone. Such techniques may promote vaccine, hormones, maybe even interferon production. Cesar Milstein, who was foremost in this research, has no ready explanation why the commercial exploitation of monoclonal antibodies slipped away to the United States where 60 firms now manufacture them. But it is a fact that Milstein made no attempt to patent his technique and gave away laboratory specimens freely. Milstein says now "We were too green and inexperienced on the matter of patents. We were mainly concerned with the scientific aspects and not giving particular thought to the commercial applications."

Who is to blame for these lapses? Industry pundits blame British scientists, locked into an ivory tower of "pure" science, for failing to see the commercial potential of their inventions. The researchers on the other hand, claim that British industry, unlike its American or European counterparts, is timid and shortsighted. (What is probably closer to the truth is a failure of communication between the two sides, and perhaps an unwillingness for academics to dirty their hands with business.) The Spinks report unfortunately does not spell out how this relationship could be much improved, beyond saying the joint CASE award scheme, pioneered by the Science Research Council, should be extended to the other research councils. Both sides blame the government for setting up restrictive safety legislation which, it is claimed, imposes an unfair competitive disadvantage, particularly in comparison with West Germany and Japan.

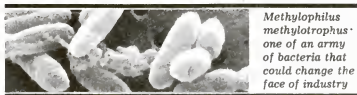
Britain's relationship with the EEC also helps to explain why British industry is reluctant to explore new ventures.

Politicking on behalf of powerful national lobbies within the EEC has, in the past, worked against the United Kingdom. The Spinks report says that although the EEC welcomes new technology in principle, "strong lobbies of established industry or agriculture tend to exert a disproportionate weight in resisting the cheaper and better products of new technology, particularly where these threaten to perturb existing patterns of agriculture." As an example the report quotes an efficient process developed in Britain using enzymes for converting maize starch into a sweet syrup, isoglucose, which could compete effectively with sugar in food processing. Millions of pounds—including a site for the factory on the Thames—was sunk into the venture before the sugar beet farmers in France successfully lobbied for heavy levies on the new product. As a result, one firm in the United Kingdom went out of business, and the development of an alternative sweetener and preservative was inhibited. The Spinks report concludes: "If the EEC policies continue to obstruct developments such as isoglucose, our ability in Europe to replace petrochemicals by producing basic chemicals from carbohydrates will be hamstrung. We are therefore concerned that all member states in the EEC and the Commission should consider the value of biotechnology in transforming agricultural surpluses and should seek to amend Common Agricultural Policy."

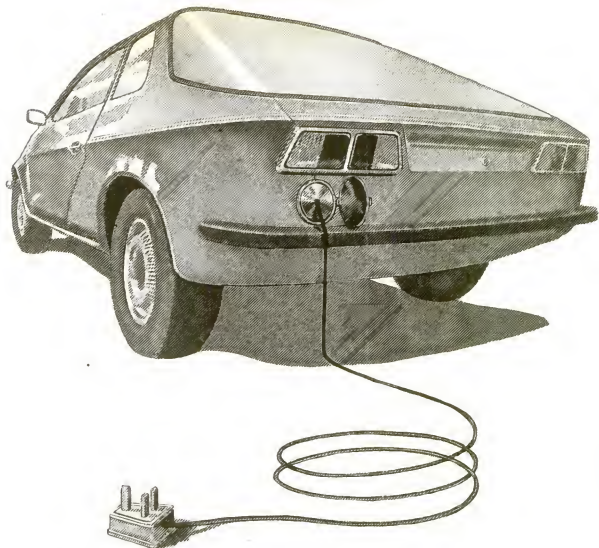
The report offers one answer to the problem of industrial finance. It recommends funding a government-backed biotechnology firm of innovative researchers along the lines of the American Cetus or Genentech. (In the early 1970s, scientists anxious to exploit commercially their ideas for profit set up, with their own money, consultancy firms. Later, with the backing of such giants as Standard Oil and Eli Lilly, these consultancies grew in size to include limited production facilities.) Although most of the initial finance would come from the NEB, Spinks believes that British industry should be encouraged to chip in half of the capital costs. In this case the NEB has turned to the City and approached four or five organisations for finance—rumour has it that Prudential Assurance is one.

Some scientists, such as biochemist Sir Hans Kornberg, see only difficulties in trying to link a government-sponsored institution to private finance. He worries that with heavy private investment in the biotechnology firm it will be difficult to safeguard the interest of the taxpayer. He asks what arrangement there will be to make sure the public receives an adequate return for its investment if private industry is free to exploit the commercial secrets of the new firm.

The Spinks report claims that biotechnology will have as important an impact on Western economies as microelectronics. One major difference, however, is that the microelectronic revolution was securely rooted in modifying a proven technology, using the well-tried skills of computer engineering. Biotechnology, on the other hand, straddles the biochemical engineers' world of massive fermentation vats and greasy machinery and the silent gown-and-gloved world of scientific investigation. Chip development was fuelled by a defined market exerting a "pull" on research. In biotechnology very few bright sparks will hazard a guess on how soon such exotics as an anti-cancer vaccine will be on the market. Indeed Peter Senior, one of ICI's bright young corporate planners, warned that biotechnology was in danger of overselling itself; "all the easiest things have been done." In Senior's warning is a note of caution that Britain's science-policy makers would be well advised to heed.



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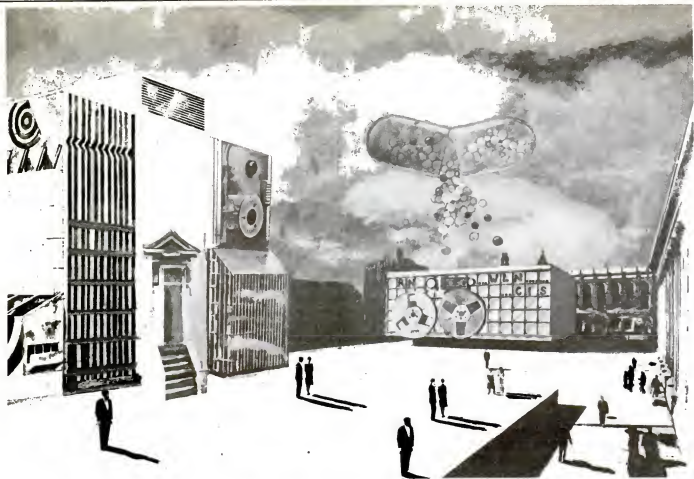
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Stephen Devane

A name for every chemical

Thousands of new chemicals appear every year and each can be named in several different ways.

But new data retrieval methods are clearing the confusion

Dr David Magrill is an information scientist at Beecham Pharmaceuticals, Betchworth, Surrey

Imagine a city inhabited by people who are not sure of their own names. Some of the citizens have four or five different names, while some are normally known only by nicknames. Others answer to vague descriptions such as "the red-haired bricklayer"; and some seem to have no names at all, although their friends and associates know them by sight. Life for these people would be extremely complicated. But save your pity for the poor chap who has to compile the city's telephone directory, and for the folk who have to use it.

There is an analogy in ordinary life for people in such an unusual predicament. Someone who wants to look up the telephone number of a person in our hypothetical "no-name" city would face a similar problem to that confronting a scientist who wants information about chemicals.

Searches through chemical data bases usually take this form: is compound X included in the data base, and, if it is, what does the data base say about X? (A data base can be taken here to mean any collection of information—examples of chemical data bases are listed in Table 1.) For instance, an analyst who wants spectral data for a compound might look in a collection of published mass spectra. A pesticide chemist with a new idea for a "wonder" compound would first check in a register of compounds that his company has already tested—just in case someone has tried his brainwave before. And an inventor with a compound to patent would hunt through every pertinent collection of

chemical facts, keeping his fingers crossed that he finds nothing to detract from the novelty of his claim.

These searches are the chemical equivalents of looking up Fred Bloggs's number in a telephone directory. But, alas, the searches may be complicated by the fact that many chemicals—as with the inhabitants of the mythical city—have ambiguous titles.

Admittedly, chemical compounds have systematic names which can be deduced by applying a set of rules. But the average graduate chemist is unlikely to be able to apply these rules with confidence. And the formal names are hardly simple or easy to remember, as the examples in Table 2 show. Generally, chemicals are known either by trivial names, such as "saccharin" or "Indigo Carmine", or by *ad hoc* names, for instance "o-sulfobenzimide" or "sodium indigotin disulfonate". Both types of title might be quite different from the "official" systematic names.

More confusion follows from the use of structural

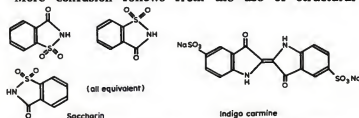


Figure 1 The formulae look different, depending on how they are drawn

Table 1. Sources of information about chemicals

| Source | Description | Format* | Reg. No. | WLN† |
|--------------------------------------|--|---------|----------|------|
| Chemical Abstracts | Abstracts and indexes to the chemical and related literature | P C O | Yes | No |
| Index Medicus Registry System | Abstracts and indexes to literature on novel organic chemistry | P C | No | Yes |
| ECDDIN | European Communities data bank for environmental chemicals | P C O‡ | Yes | Yes |
| Central Patents Index | Abstracts and indexing of chemical patents | P C O | No | No |
| Chemical Information System (CIS) | Unified collection of data banks including: CNMR— ¹³ C NMR spectra MSS—mass spectra CRYST—X-ray crystal structures PDSM—X-ray powder diffraction OHM-TADS—oil and hazardous materials RTECS—toxicity Merck Index | P C O | Yes | No |
| BIAM-S | Data bank on medical specialties | O | — | — |
| BIAM-PA | Data bank on active principles of drug compositions | O | — | — |
| CIMI-Drugfile | Data bank of ingredients of marketed drugs | C | Yes | Yes |
| CAOCI | Commercially available organic chemicals—an index to suppliers' catalogues | P C | No | Yes |
| IRIS | Data bank of infrared spectra | P O | — | — |
| Pomona College Medical Chem. Project | Data bank of pK values of organic compounds in various solvents | P C | † | Yes |
| Merck Index | Encyclopaedia of chemicals and drugs | P C O | No | Yes |
| RTECS | Data bank of toxic effects of chemical substances | P O | Yes | No |

* P—Printed or microform version available

C—Computer tapes available

O—Searchable on line

† Registry numbers and WLN's are not necessarily supplied by the original compiler.

‡ Registry Numbers will be added

§ Due on line with Euronet

‡ Applies to certain components only

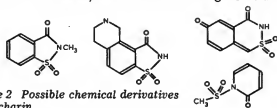
formulas. Chemists find it easier to think of structurally complicated compounds, especially organic ones, in terms of structural formulas, such as those shown in Figure 1. These formulas are two-dimensional representations of the three-dimensional arrangement of atoms in a molecule of the compound. And, as Figure 1 shows, they can be drawn in many different ways—just as an object might be photographed from a number of different angles.

Clearly, pictures of different structural representations and *ad hoc* or trivial names are useless for compiling a chemical "telephone directory". To make matters worse, scientists often want information not merely on a single substance but on several structurally-related compounds.

Table 2. Saccharin and carmine by many other names

| Trivial | Saccharin | Indigo Carmine |
|--------------|--|---|
| Systematic | 1, 2-Benzisothiazol-3(2H)-one, 1, 1-dioxide | 2-(1, 3-Dihydro-3-oxo-5-sulfo-2H-indol-2-ylidene)-2, 3-dihydro-3-oxo-1H-indole-5-sulfonic acid disodium salt |
| Others | o-Sulfobenzimide Benzoic sulfimide 1, 2-Dihydro-2- ketobenzisulfonazolo | 5, 5'-Indigotin disulfonate 3, 3'-Dioxo-Δ ^{2, 2'} - b[2,1-b]indoline-5, 5'-disulfonic acid disodium salt Sodium indigotin disulfonate Acid Blue 74 C.I. Food Blue 1 FD & C Blue No. 2 etc |
| | Benzoisulfimide Garantose Saxin etc | |
| Registry No. | 81-07-2 | 860-22-0 |

For example, imagine that a toxicologist thinks that a food additive may be a carcinogen (a cancer-causing compound). He will then want to know whether any related compound causes cancer. He will also attempt to find out if there are similar compounds which people eat that should also come under suspicion. Chemists might consider two compounds to be related if they have some structural features in common, as illustrated in Figure 2. However,

**Figure 2** Possible chemical derivatives of saccharin

the relevance of such relationships would depend on the chemical, physical or biological properties under consideration. In practice it could be difficult to assess whether two chemicals that look alike really are similar.

The biggest source of data available to chemists is Chemical Abstracts. Produced by the Chemical Abstracts Service (CAS), this data base includes details of about 4.5 million substances. Each year the service enters data about some 350 000 new chemicals and also adds information about the original 4.5 million. CAS enforces its own rigid rules on nomenclature and uses the resulting names (see Table 2) in its indexes. However, users can rarely go straight to a compound's name in the service's "chemical substance index". Generally, supplementary lists act as "indexes to the index" to help users through the jungle of names.

The systematic names, however, are only part of a complex, highly automated procedure developed by CAS to cope with the mammoth task of indexing the chemical literature. Records about all the compounds are kept in what are called "connection tables". In theory, the connection table for a particular compound is simple to work out. A number is assigned to each atom in the molecule. (This is except for hydrogen atoms whose presence is inferred from the valency of the atoms to which they are joined.) Then for each atom, a record is made of what element it is, the number of its neighbour, and the nature of the bond that links the two—for instance, a single or a double bond. See Figure 3 for a schematic example. Although people find

| | | | | |
|-----------|---|-------------|---|---|
| | | Acetic acid | | |
| Atom No. | 1 | 2 | 3 | 4 |
| Element | C | C | O | O |
| Bonded to | 2 | 3 | 2 | 2 |
| Bond type | S | D | | S |

Figure 3 The connection table for acetic acid

connection tables difficult to digest, computers can store and manipulate these tables fairly easily. To round off the classification process, each unique CAS connection table is assigned a registry number (RN): this identifies a compound in much the same way as a national insurance number might identify a person.

We have hitherto talked in terms of chemical "telephone directories"—implying that searchers find their information by flicking through pages. However, many chemical data bases are now most effectively searched by computer. Searches may be made "on line", where the searcher, armed with a small terminal, "converses" with a computer (which is often some distance away) to get immediate answers; or the queries may be run in a batch at times when the computer is not heavily used.

To look for information on a compound, the searcher must first describe it. In many important data bases, includ-

ing Chemical Abstracts, the registry number is accepted as the way of defining the substance. Often the researcher has a problem as he does not know the number in the first place. He finds it either by consulting a printed index or a computerised dictionary.

This approach, then, helps a researcher to find information about a single compound. But different problems confront workers who want to discover facts about a group of chemicals. Such people might want data on the toxic effects of a family of compounds. Or they might seek spectroscopic information on a range of substances with, say, a 2,4-dinitrobenzene ring. Searches of this type are more difficult because parts of structures, rather than complete molecules, must be considered. Fortunately for a lot of chemists, methods are available for dealing with these "substructure" searches.

Two American agencies, the National Institutes of Health and the Environment Protection Agency, have tried one approach. They have assembled a group of data banks, each based on a collection of compounds, into an integrated system. This is publicly available on line and is known as the Chemical Information System (CIS). It features an integrated set of CAS records relating to all the compounds included in the system. Chemists can select compounds by the substances' registry numbers, as well as by systematic names and by some trivial names.

Additionally, the user can "draw" a structure or substructure by keying special instructions on a terminal. The CIS programs then compare features of this "query structure" with features of the compounds in the data bank. In this way, the searcher might identify chemicals with, for instance, similar ring systems or with an interesting group of atoms embedded in the substances' structures. The worker might then go on to retrieve information about these compounds from the component data banks, which include information on compounds' toxicity, X-ray diffraction patterns and spectroscopic behaviour.

Chemical cast of thousands



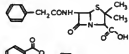

While many people interested in chemical data need to search through an appropriate set of only thousands, or tens of thousands, of compounds to find the information they require, some queries require a search of all the 4-5 million compounds on the CAS file. The CIS search software is still far too slow to cope with such a huge search. However, researchers are developing new software techniques to deal with these searches.

A completely different approach to retrieving data about chemical compounds involves what is called "linear notation". Here no effort is made to name a compound in the orthodox sense. Instead, a string of characters represents the compound's structure. Many ways of assigning the characters have been proposed, but only one, Wiswesser Line Notation (WLN), has gained widespread acceptance.

A compound's WLN is unambiguous (disregarding substances which have different stereochemical forms for which special provision must be made). It is also unique to that compound. WLN's can therefore be handled by indexing procedures, especially computer-based ones, as though they were orthodox systematic names. People can write WLN's extremely fast—much faster than they could ever write a chemical's full systematic name—and the skill is easily learned, even by non-chemists.

A few examples (Table 3) illustrate the essential simplicity of WLN. Ethanol becomes "Q2" where "Q" represents the OH group and "2" signifies a 2-carbon chain. In isopropanol, the branching carbon is denoted by the mnemonically-chosen symbol "Y", and the symbol "&" acts like a punctuation mark at the end of a chain. The third example, nicotinic acid, contains a ring which, by convention, is described by the symbols between "T" and "J". In this example only the size of the ring and hetero-atom (in

Table 3. Wiswesser Line Notations

| Chemical | Formula | WLN |
|--------------------|---|------------------------------|
| Ethanol | $\text{CH}_3\text{CH}_2\text{OH}$ | Q2 |
| Isopropanol | $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ | QY1&1 |
| Nicotinic acid |  | T6NJ CVO |
| Phenylethanolamine |  | QVZ1R |
| Benzylpenicillin |  | T45 ANV ESTJ CMVR, FI F1 GVQ |
| Phenolphthalein |  | T56 BVO DHJ DR DQ& DR DQ |

this case nitrogen) needs to be specified. Hence the ring is defined as "T6NJ". The symbol "C" gives the position of the chemical group substituted on the ring in relation to the hetero-atom (nitrogen) residing (in this simple case) at position "A". "VQ" refers to the "COOH" group. Table 3 includes the WLN's of other, more complex molecules; they too, can be reduced to series of characters.

Clearly it is easy to list WLN's in alphanumeric order and to consult the list for the WLN of any required compound. Taking the procedure a step further, WLN's can be listed as a permuted index where every symbol that denotes a chemical grouping generates an individual entry. For instance, a compound with four important chemical groups would generate four entries. Thus nicotinic acid would lead to entries for the T, N, V and Q groups, using WLN symbols.

With such an index, compounds with similar chemical groupings are often listed together so that chemists can identify certain families of compounds with relative ease. The major example of a permuted WLN index is the Index Chemicus Registry System (ICRS). Table 1 shows other data bases which use WLN.

Many research-based organisations, such as pharmaceutical and pesticide companies, use WLN's to keep track of the thousands of new compounds they produce every year. Among the software systems available to handle WLN is the CROSSBOW suite, developed by ICI. This checks each notation for a host of possible errors before adding it to a master file. CROSSBOW boasts an efficient search system which, if necessary, converts WLN's into connection tables that are scanned, atom-by-atom, for a required structural feature. The system can also draw structural formulas on an ordinary line printer. Thus a chemist who finds interesting biological activity in a compound can search his company's files for any other compounds with the structural feature that he believes is significant.

Although the area of chemical information is strewn with traps for the unwary, researchers are trying to simplify the task of getting access to data bases. Ideally the user of a chemical information system should be able to frame a request in whatever form best suits his needs and expertise. This form might be a trivial name, a registry number, a structural formula or a partial structure. Most of today's systems demand some specialist knowledge, either on the part of the searcher or of an intermediary, but new ideas and new systems are emerging. For example, several systems allow the chemist to denote the structure in which he is interested using a light pen on special computer terminals. Future developments will undoubtedly lead to increasingly simple interactions between the systems that store chemical data and the scientists who need access to them. □

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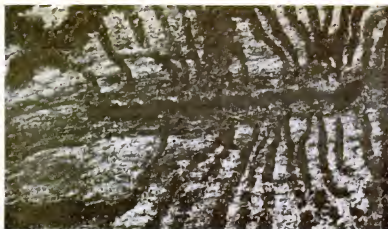
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Elms die in rows: they are connected underground



Where *Scolytus* and its larvae have tunnelled beneath the bark

Dutch elm disease: a catalogue of follies

John Benyon

is a lecturer in the Department of Politics at the University of Warwick

Each summer for more than a decade, Britain has stood by and watched the destruction of large stretches of its landscape; Dutch elm disease is now estimated to have killed more than 17 million of the 23 million elms in southern England, and is still spreading. Yet the epidemic need not have happened, and certainly need not have been allowed to reach such proportions. A few counties, notably East Sussex, have shown that the disease can be contained, but central government has failed to provide the leadership, publicity, and above all the finance that were needed over the whole country; indeed, their record throughout the 1970s has been a catalogue of folly and missed opportunity. Yet even now it is not too late to save most of the elms in the North—or indeed to apply the political lessons of this disaster to comparable threats to the environment, whether they be other diseases of trees, such as oak wilt, or oil tankers wrecks like the *Eleni V*.

The fungus that causes Dutch elm disease, *Ceratocystis ulmi*, is carried into the sap by beetles of the genus *Scolytus*, which tunnel into the bark during summer and autumn to lay their eggs. These hatch, the larvae pupate in the bark, and the new generation of adults emerges the following season to carry the spores to yet more trees. In addition, the fungus may travel from tree to tree via the roots, for the elm spreads by producing suckers, and whole clumps or rows of elms in coppices or hedgerows may be connected underground. The tree's own defensive actions, and the fungal toxins, block the sap vessels: the leaves wilt, turn yellow, and die. But the fungus remains to colonise the bark, and produce spores.

Dutch elm disease was first identified in Britain more than 50 years ago—in 1927. The epidemic led to the deaths of some 10 per cent of elms in the South in the succeeding 10 years. During this period the infection spread to North America. Although the disease continued to affect some elms in England—but rarely in the north and in Scotland—by the late 1930s it was regarded as a relatively minor nuisance which was unlikely to become a major threat unless a more aggressive strain developed.

As early as 1928 the Forestry Commission had decided that eradication was not possible. The prevailing attitude was of *laissez-faire*: there was no demand for widespread sanitary felling. Importation of elms was prohibited, however, but this quarantine measure was relaxed in 1949. During the 1950s some elementary work was conducted with fungicides and insecticides, but these were not extensively employed because their effectiveness was limited and they

were expensive to apply.

The present epidemic began in the late 1960s. Unbarked elm logs from Canada introduced a new aggressive strain of *Ceratocystis*, although this was not identified until 1972. Had measures been introduced immediately the disease may have been contained, but there was very little action until the Dutch elm disease Order of 1971 empowered local authorities to order the felling and burning of infected trees. The government granted £250 000 to aid this sanitation policy. By 1972 over two million dead elms were estimated in the south of England; yet in that year the Minister of Agriculture—Mr Joseph Godber—withdraw the previous year's sanitation order and grant. With hindsight, this decision must be criticised as a major factor which allowed the disease to spread. The bark of mature elm trees is suitable for breeding beetles for two years after death, and the failure to remove these breeding reservoirs must have fostered the spread of the disease.

In 1974 the government re-introduced the Local Authorities Order for areas where sanitation was felt to be effective, but did not provide any money to carry out this policy. Also in 1974 the Dutch Elm Disease (Restriction of Movement of Diseased Elms) Order at last prohibited the movement of unbarked and untreated



Sanitary felling: "had a sanitation policy been introduced and suitably



Unbarked boles wait to be made into furniture

Successive governments dithered while the Dutch elm epidemic gathered strength throughout the 1970s.

We could still save many trees—provided we act incisively

elm timber in lightly affected (unscheduled) areas. This measure came far too late to help the south, however, and probably too late to prevent the spread of the disease to northern elms. The first cases in the north occurred in 1973, in East Yorkshire and Northumberland. These cases were close to timber yards; transport of diseased trees, which harboured the fungus and probably the beetles, clearly carried Dutch elm disease into previously unaffected areas.

Even after the Restriction on Movement Order was introduced the problems of enforcement remained. The Forestry Commission is made responsible for this, but it has brought very few prosecutions, and the fines have been too low to be a serious deterrent: the maximum is £100.

By 1976 the disease affected an estimated 9 million elms in southern England. An amendment to the Restriction on Movement Order placed further restrictions on elm tree movement; but this amendment was then further amended to allow some movement—another example of government action that was only half thought out.

Although the national sanitation programme was abandoned early on one area in particular persevered with a vigorous policy. East Sussex has a large population of elms and was fortunate in having

natural boundaries which could be incorporated in a *cordon sanitaire*. Only 13 per cent of elms have died compared with 91 and 65 per cent in neighbouring counties.

East Sussex have used the Dutch Elm Disease (Local Authority) Orders, but have supplemented this compulsion by inducements—wide publicity, grants, and direct help for owners. By using direct labour, and having the necessary equipment at hand, they can carry out treatment rapidly. As a result of the extensive publicity fewer unbarked logs are stored and more cases are notified. Accurate records are kept to monitor the disease.

East Sussex has also stressed the importance of replanting various species of trees in place of diseased elms, and this re-planting is extensively subsidised by the county and by the Countryside Commission.

The county's success seems to lie with the policy of felling diseased trees, thus removing the major sources of fungus and the beetle's breeding grounds. Fungicides have also been used in an attempt to save high-value amenity trees. In general, limited trials with insecticides and fungicides have proved disappointing, but the fungicide Lignasan, in particular, has produced more than 43 per cent protection, if used in conjunction with a vigorous sanitation policy and root severance. East Sussex have also helped to market elm timber, which has many uses.

Too few restrictions, too weakly enforced

Overall, however, the story of Dutch elm disease in southern England is a sorry catalogue of errors and blunders. The removal of import controls in 1949 was to some extent understandable. But the failure to prevent the importation of unbarked elm until 1974 was a major error. It is surprising that the Ministry of Agriculture did not appreciate the havoc that was being wreaked in North America, and take action to stop the disease reaching England. In the early 1970s the government dithered: first they gave local authorities powers to carry out a sanitation programme, then revoked those powers, then re-introduced them in 1974.

Throughout, central government offered little or no financial inducement and help, and lack of finance has been a major factor in the failure of a sanitation policy. All over southern England dead and dying elms are reservoirs of the fungus, and breeding grounds for the beetle. Had a sanitation policy been introduced, and suitably financed, the disease could at least have been restricted and at best eradicated, as East Sussex has shown.

The vigorous national sanitation programme that should have taken place—and still could—could not have been effective without control on the movement of diseased elm.



financed the disease could at least have been restricted . . .

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It is incredible that elm timber was moved freely around the country until 1974; and even then the Order was not vigorously enforced.

Injections have been used, but often not in conjunction with other action; many local authorities have spent time and money injecting trees and yet have failed to fell diseased ones. The Forestry Commission does not seem to have provided central leadership.

Yet there is hope. In northern England and Scotland, Dutch elm disease is still not widespread. It can be controlled and possibly eradicated. The climate limits the beetles' activity (although the hot summer of 1976 was very favourable to it) and there are natural barriers which may prevent the beetle reaching certain areas—unless carried there on infected timber.

In 1975 the northern counties established a working group to investigate Dutch elm disease in the area. The Forestry Commission and the Countryside Commission participate in this group. Their report shows a high incidence of the disease near timber yards and traffic routes. This is too high to be coincidental. Secondary movement of low-quality timber products, such as mining props and pallets, also appears to be dispersing the disease. Present controls on movement are clearly ineffective.

The northern counties' strategy is based on controlling the movement of timber and destroying diseased trees. They are seeking to involve the public through wide publicity. Yet their campaign is hampered by lack of resources: only one authority (Northumberland) has taken on staff to fight Dutch elm disease, and then only one person! The felling programme is proceeding except in North Yorkshire and Lancashire, whose councils feel they can no longer cope. To be effective, felling has to be carried out quickly before the beetles breed. Control of timber movement rests with the Forestry Commission. The northern counties have appealed for government help in their fight; surely Whitehall will now provide funds.

Dutch elm disease control has not been placed on the political agenda. William Solesbury in *Public Administration* (vol 54, p 379), has discussed how issues may "succeed or fail to command attention, claim legitimacy and invoke action". The issue of Dutch elm disease has only partially succeeded in each of these three stages. As far as government is concerned the disease is a non-issue. The lack of public attention has meant that central government has taken little action and committed few resources.

The Forestry Commission is said to have "written off" the remaining 7 million elms in southern England. As the environmental impact of the loss of the elm becomes fully apparent many people are beginning to realise the real cost of the inaction. Now a new tree disease—oak wilt—which is rife in the US threatens Britain. Let us hope that we can learn from the sad story of Dutch elm disease. □

Publicity in East Sussex—a vital part of the county's successful containment campaign



Monitor

New chemical perspective on photovoltaic cells

Jeffrey Fox, Washington

Peculiar experimental findings have prompted a group of chemists to devise a new explanation for how liquid junction, light-activated semiconductor work. That explanation could help them design more efficient solar cells.

The new model for liquid junction semiconductors comes from Allen J. Bard of the University of Texas (Austin), Mark S. Wrighton of Massachusetts Institute of Technology and their colleagues (*Journal of the American Chemical Society*, vol 102, pp 3671, 3677 and 3683). Already other researchers are disagreeing with Bard and Wrighton's interpretations, although there is general agreement that the experimental findings call for some new explanations.

Bard and Wrighton have found that the amount of chemical energy that light-sensitive semiconductors produce when illuminated differs from predictions of the generally accepted theory. For a given type of semiconductor bathed in a chosen chemical solution, the conventional model prescribes just how much electrochemical work a given amount of light can do. The original model suggests that the output of the semiconductor varies with the chemical make-up of the solution; Bard and Wrighton say that the semiconductor's output seems to be fixed, at least for a wide variety of materials that might go into the solution.

This behaviour is attributed to what Bard and Wrighton call Fermi level pinning, a term (and a concept) borrowed from solid state physics. Fermi level pinning refers to the behaviour of the electrons that are involved in energy transfer. The Fermi level for a particular system is a measure of the energy associated with the quantised states of the electrons that move through the semiconductor. This movement gives rise to a current: the Sun's heat converted to electrical energy.

Theory predicts that the Fermi level should differ substantially with a change of surrounding materials. But Bard and

Wrighton have shown that the value is insensitive to the nature of the materials, and so the energy transfer remains the same. They can only suggest that it is the nature of the surface that is responsible for this effect.

Whatever the reason behind it, the new result could inspire solar energy experts to try using the Sun's light to drive chemical reactions previously thought impossible because they required more energy than seemed to be available. But it also has a more negative implication: that light-sensitive semiconductor materials are less versatile than scientists had thought.

The best known and most successful liquid-junction photocell is the kind found in green plants. Chemists would like to turn the semiconductor-based photocells that they study into efficient apparatuses to rival plants in their ability

to split water into its component gases, hydrogen and oxygen. Such a man-made photocell would provide hydrogen which could be produced as a fuel.

Unfortunately, currently available photocells, such as the ones studied by Bard and Wrighton, convert water into hydrogen and oxygen far too slowly to be useful. Wrighton says that their results imply that the overall process could be speeded up, because the new model (and the phenomena that it describes) permits chemistry that the old model precluded. Thus, for example, the MIT group has introduced a couple of chemicals known as a bipyridinium pair to a solution bathing a light-sensitive silicon electrode. That chemical pair speeds the hydrogen-releasing part of the water-splitting reaction in the photocell. Bard, at Texas, has been working with a gallium arsenide electrode in an iodide cell. □

Successful breeding puts stags out of condition

During the rutting season mature stags leave their bachelor herds and fight for the possession of groups of hinds. Recently interest in rutting has centred around two questions. Are all stags equally good at producing offspring? And if not, at what expense are some more successful than others?

To answer these questions, R. M. Gibson and Fiona Guinness of Sussex and Cambridge Universities analysed data collected over the past five years on the reproductive success of 37 stags on the Isle of Rhum (*Journal of Animal Ecology*, vol 49, p 199).

Some stags are simply better at siring offspring than others—the most successful father 11 times as many. This variation is not simply due to stags achieving high reproductive success at a certain age. Although there is a slight peak in success between 6 and 10 years of age, it is not a significant one. Moreover, by comparing the fertility of the



Fecund stags wear themselves out

hinds in each harem, Gibson and Guinness ruled out the possibility that some stags had more offspring just because their mates were more fertile.

The stags that are more successful pay a price for their genetic success. In the spring following the rut stags cast their antlers. The date the antlers are cast provides a reliable index of body condition during the winter: animals that show external signs of poor body condition cast their antlers later.

If energy costs increase with reproductive success, we might predict that successful breeders should cast their antlers late as a result of poor over-winter condition. This is exactly what happens. High reproductive success is achieved at the expense of lowered body condition. Does this affect a successful breeder's chances of surviving the winter? Gibson and Guinness will explore this possibility as soon as they have collected more data on winter mortalities. □

Astronomers get smoke in their eyes

The explosive eruptions of Mount St Helens in Washington State in May and June may well have consequences for astronomers as well as the widely publicised possible effects on climate. Astronomers at Kitt Peak National Observatory (KPNO) in Tucson, Arizona, have already begun forecasting the possible changes in observation conditions due to the injection of volcanic dust into the upper reaches of the atmosphere. They base their predictions on precedents from the past century (KNPO Newsletter, no. 9).

Tom Kinman, one of the editors of the newsletter, notes that research in 1973 showed that the extinction (the atmospheric absorption) over the visible spectrum at Mount Wilson in California doubled after the eruption of Mount

Katmai in Alaska in 1912.

More recently, in 1963, Mount Agung on the island of Bali blew its top, resulting in a tripling in the extinction measured at observatories in Australia and Chile over six months later. Luckily for astronomers making accurate photometric observations, the proportion of light absorbed by the dust does not depend on wavelength. So the whole spectrum got fainter—there was no artificial colouring.

Measurements of well-known stars over the next year or so, with their calibrated brightnesses, should tell the astronomers what sort of corrections are needed to their observations. The extinction data will also indicate to atmospheric scientists how quickly the dust content tails off. □

Monitor

continued

'Normal' lead levels are too high

How much "natural" lead would children have in their blood if they weren't exposed to the toxic metal from car fumes, from the solder in tin cans, from paint, from water and from smelters? According to researchers in Australia and Papua New Guinea, previous estimates of the "normal" range of lead concentrations in children's blood are much too high. So lead levels in children in cities that researchers thought not too "abnormal" suddenly look more ominous.

Clearly, it is impossible to measure "normal" levels of lead in the blood of children living in cities—there are so many sources of lead in the environment, food and water, that children in cities cannot avoid all of them. So researchers have traditionally measured lead levels in the blood of children in remote rural areas to provide a "baseline" against which to compare the lead burdens of city children. Many of these measurements were taken some time ago, when analytical techniques were not as sophisticated as they are now. And according to C.

Poole, L. E. Smythe (of the University of New South Wales) and M. Alpers (of the Papua New Guinea Institute of Medical Research), measurements taken a decade or so ago over-estimate the amount of lead that children in remote rural areas have absorbed.

For example, one survey of studies of the lead burdens of rural children in New Guinea, East Africa, Bechuanaland, Peru, Brazil and the Marshall Islands reported that the mean of lead levels in their blood ranged from 13 microgrammes/100 millilitres to 23 $\mu\text{g}/100\text{ ml}$. But Poole, Smythe and Alpers found that 100 schoolchildren in a remote part of Papua New Guinea had levels of lead in their blood ranging from 1 to 13 $\mu\text{g}/100\text{ ml}$. The mean of these levels was 5.2 $\mu\text{g}/100\text{ ml}$ —well below the range of means found in previous studies (*Science of the Total Environment*, June 1980, p 17).

The three researchers believe that earlier investigators' estimates of the amounts of lead in the bodies of children in rural areas are too high because of

various deficiencies in the sampling and analysis they did. For example, Poole, Smythe and Alpers analysed blood samples from the children in Papua New Guinea in a special "clean" laboratory (which was established for a much larger study in the bodies of schoolchildren). They say that normal laboratories are contaminated by airborne lead from street dust and claim that they have reduced this pollution in their "clean" laboratory by over 80 per cent. Further, analytical techniques such as atomic absorption spectrometry have improved enormously in the past.

The importance of this research is clear: if the results Poole, Smythe and Alpers obtained are confirmed in other areas, researchers will have to assume that "normal", background levels of lead in the blood of young children are much lower than they had thought, and this change in thinking means that the levels of lead in many children in cities are, by comparison, "abnormal". Almost all researchers now agree that even very low levels of lead cause psychological damage to young children. □

Bonanza of interferon antibody springs from a single cell

An important technical breakthrough in the purification of interferon—the human antiviral agent which may attack cancer—could bring it into the fight against disease much earlier than predicted. An article in *Nature* (vol 285, p 446) describes collaborative work by David Secher at the Medical Research Council's Unit of Molecular Biology, Cambridge and Professor Derek Burke at Warwick University based on fused cells. They yield interferon 5000 times purer than the extracts currently used in research.

Conventional preparations are extracts from human cells stimulated to produce interferon in response to viral attack. The cells secrete minute amounts of interferon; the concentration of the protein can be as low as 0.1 per cent. Scientific research has been held back by the small amounts of pure interferon available and results from clinical trials to test the impure preparations are equivocal.

Cesar Milstein pioneered the method for producing hybrid cells at the Cambridge unit. Milstein takes cells from the spleen of animals immunised against a wide variety of foreign substances, and fuses them with a fast growing human cancer cell. In response to attack by the "intruder" the spleen of these mice mounts a vigorous defence—its cells secrete an antibody very specific to the antigen. The new hybrid cell—hybridoma—combines the properties of the human cancer cell, with those of the mouse cell. In a soup of appropriate nutrients, a single cell will multiply endlessly and produce large quantities of a very pure antibody. The preparation consists of a colony—or clone—of many generations of a single cell: so it's called monoclonal.

Secher and Burke immunised their mice with an extract of human interferon, a gift from the British pharmaceutical firm Burroughs-Wellcome, whose laboratories have been producing it for the past two years. The hybridoma they developed secretes antibodies to this interferon. The researchers coat the inside of a separation column with beads made of carboxylate, to which the antibodies are attached.

The antibodies trap and bind molecules of interferon from solutions passing down the tube. Other chemicals remove the interferon from the sides of the columns: the washings are now 20 to 50 per cent interferon, a respectable improvement on the purity of conventional preparations, which is about 1 per cent.

Genetic engineering firms such as Europe's Biogen and the American Genentech are racing with the pharmaceutical giant Searle to develop a commercial method of producing interferon using genetically engineered bacteria as manufacturing powerhouses. Unfortunately, these processes still leave a minute amount of interferon to be separated from the vast amounts of bacterial debris—and this is where hybridomas could play a part. At the very least, access to a pure source of interferon will accelerate research on when cells secrete interferon and its effects on viruses and cell growth—which play a key part in interferon's potential as an anticancer agent.

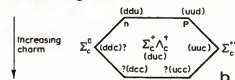
Burroughs-Wellcome is very interested in incorporating Secher and Burke's monoclonal antibody into its process for making lymphoblastoid interferon—which comes from Burkitt's lymphoma—although their product matches the purity of interferon that comes out of Secher and Burke's columns. Other com-

mercial firms such as Searle abandoned work on this particular type of interferon because of the danger that these cells may pass on the small portion of a virus which each contain and is implicated in certain types of cancer.

There are four known types of interferon, including Wellcome's lymphoblastoid interferon, but the two most frequently used in clinical trials are made from "safer" materials—human leucocytes (white blood cells) and fibroblasts (connective tissue). But Wellcome's protein comes from a cancer, Burkitt's tumour.

Britain's Committee for the Safety of Medicines passed lymphoblastoid interferon for testing in clinical trials. And Dr Frances Balkwill, an interferon researcher, told *New Scientist* that there is less than one molecule of the Epstein-Barr virus in 10 million units of interferon. The argument is largely "emotional", she said. □

Charming mistake



Some errors crept into the diagrams that accompanied our report of a new charmed particle ("Charming debut for a sensitive target", 19 June, p 311). Thanks to the close attention of Trevor Kennedy of Salford, we now bring you the correct version. The diagram shows how the new particle Σ_c^{++} fits into the pattern of charmed particles. Kennedy also points out that the Ξ^- particle shown in the other chart in the same article is made up of quarks dss , not as shown.

Glucose powers the fertilising sperm

Glucose is the vital energy source which enables sperm to penetrate and fertilise ova, according to new results from Chelsea College in London. The discovery could boost the development of contraceptive drugs that don't depend on harmful hormones but inhibit the glucose energy source.

Lynn Fraser and Peter Quinn of Chelsea College in London, discovered glucose's crucial role when they fertilised eggs extracted from mice—the results probably apply to humans as well. Lynn Fraser, who devised the experimental technique, has found that if the fertilisation medium lacks glucose (normally present in the female tract), two important steps towards fertilisation fail to occur.

Normally the sperm head loses its outer membrane releasing a store of enzymes that break down the egg's outer layers. In the absence of glucose, the sperm fails to release the enzymes, so it cannot penetrate the egg.

Secondly, there is no change in the way the sperms move in the early stages of their passage through the female reproductive tract towards the egg. After some hours—when they should be approaching the eggs—this tail waving becomes a very vigorous "whiplash" action. Fraser has now confirmed that this mechanical whiplashing enables sperm to penetrate the several layers of cells that surround the outer membrane. But without glucose they never begin to move this way—and so have an even smaller chance of fertilising the egg.

Both the enzyme release and the change in motion occur almost immediately if glucose is placed in the medium. Quinn and Fraser find it puzzling that the sperm cannot make use of another common energy source, fructose, which surrounds them in the male. Fructose seems to play no part in enabling a sperm to fertilise an egg.

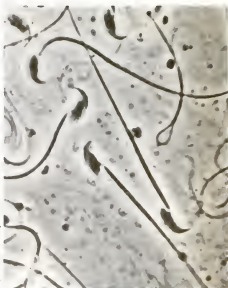
Glucose and fructose are broken down by different enzymes in the cell. Peter Quinn thinks that the enzyme glyceraldehyde-3-phosphate dehydrogenase is the key enzyme in the two barred steps in fertilisation. Quinn admits that the idea is mainly speculation, but there is some evidence to support it. The contraceptive alpha-chlorohydrin, which has been tested on males, is known to inhibit the action of the enzyme.

Alpha-chlorohydrin has some undesirable side effects but Quinn suggests that men use other drugs that inhibit the enzyme. The antibiotic pentanoloactone is a possible candidate. An interesting alternative would be to supply extra glucose to the ejaculate or epididymis (the ducts where sperm are stored), to induce premature changes that would prevent successful fertilisation later on. Taking glucose orally probably won't have the desired effect because there may be a barrier which prevents blood glucose from passing into the epididymis. But, says Quinn, this barrier could

be broken down by a simple drug.

The new results also suggest a new form of spermicide that the woman could use, which would contain a chemical that destroys all the glucose in the female tract. The research may also have some bearing on the test-tube baby technique. One of the problems with this *in vitro* method is that very high sperm concentrations are needed to achieve effective fertilisation. Sometimes two or more sperm fertilise the egg—this then grows but dies at an early stage in development. Unfortunately, there is no way of knowing whether an implanted egg has this defect.

Lynn Fraser believes that her glucose technique can improve the likelihood of fertilisation outside the body. Sperm concentrations in the medium for fertilising human eggs outside the body could be lowered, reducing the risk of abortions due to multiple fertilisation.



Mouse sperm

Electrons probe magnetic changes

A new experimental method for studying the outermost atomic layers of a magnet promises to become a powerful tool in the rapidly advancing field of surface magnetism. Already it has produced results important for the magnetic components, for example, in computers. The technique, spin-polarised low energy electron diffraction—PLEED for short—has been developed by Daniel T. Pierce and his colleagues at the National Bureau of Standards in Washington, in collaboration with a group at Argonne National Laboratory, Illinois (*Dimensions*, vol 64, p 26).

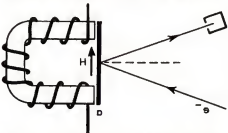
Electrons are already widely used in surface analysis. The probe particles interact strongly with the diffracted or emitted electrons—electrons of the sample; only the outer layers of atoms are explored by the probe particles. Pierce's innovation is to use beams of

electrons with their spins all aligned in one direction, which have a particular advantage for studies of surface magnetism. The electrons have a known direction of polarisation—and it is the relation between this direction and that of the magnetic field that determines the intensity of the scattered electron beam. Scientists can use this technique to measure the magnetic properties of atoms in the outer layers. They could use PLEED to investigate, for example, how magnetic properties vary with changes in temperature and applied magnetic fields.

Pierce and his colleagues had already developed a good source of spin-polarised electrons: a gallium arsenide gun that produces a highly polarised electron beam of constant intensity. The spin-polarisation changes typically 37 times every second.

Pierce and his colleagues describe studies of the magnetisation of the outermost two atomic layers of a single crystal of nickel. They measured the variations in the surface field as the field imposed by the electromagnet changed it and found—as earlier observations had suggested—that the way the surface field grows is very sensitive to surface contamination. Quite small concentrations of sulphur, in particular, can completely destroy the magnetisation of the surface layers. Effects like this are of considerable technical interest because impurity absorption and superficial corrosion of magnetic components are a major cause of computer breakdown.

Theorists, too, stand to benefit from the PLEED technique, since reliable experimental results with which to test models of surface magnetism are currently hard to come by. The NBS team has collected preliminary data bearing out one theoretical prediction—that the magnetisation of a body decreases close to the surface.



A beam of spin-polarised electrons hits a nickel crystal in the form of a thin slab. The crystal forms the "keeper" of the electromagnet used to impose the field—this reduces stray fields, which tend to deflect and depolarise the electron beam, to a minimum. The applied field—a typical value is 1600 ampere/metre—aligns the magnetisation parallel to the surface. The electrons—accelerated through 125 volts—penetrate the two outermost layers of atoms. Those scattered backwards by the atoms can be collected as shown.

Monitor

continued

Privileged researcher gives more time to immune confusion

Not long ago, John Newsom-Davis and some of his team spent most of the night in the lab, separating the helper and suppressor cells of the immune system from an extract of human thymus brought from the operating theatre. If he had spent a long day seeing patients or knew he faced ward rounds in the morning, Newsom-Davis admits, he would not have been eager to perform intricate cell separations late into the night.

Newsom-Davis, a practising neurologist as well as a researcher, now has less of a problem finding time for science. He is the Medical Research Council's Clinical Research Professor, an appointment which gives him a permanent guarantee of time for research. By choice, Newsom-Davis still spends about two days a week seeing patients at the National Hospital for Nervous Diseases, but he now spends the rest of his time in his lab at the Royal Free Hospital, investigating the causes of myasthenia gravis (MG).

Newsom-Davis is one of the few scientists in the UK who are investigating the immune mix-up inside people with MG. The disease causes antibodies to be formed that block the signals from the nerves to the muscles. The solution to the problem may hold clues to other auto-immune diseases (such as multiple sclerosis and some forms of arthritis) in which people's internal defence systems begin to attack their own tissues (*New Scientist*, vol 82, p 805).

For people who have MG, the disease can be devastating, making them powerless to command their own muscles and sometimes unable to breathe. But for researchers it is one of the most satisfying auto-immune diseases to study because some aspects of it are well understood.

Many patients who have MG make unusual types of antibodies (the molecules intended to attack invading microbes) which recognise and bind to structures called receptors on the surface of their muscle cells. These receptors normally recognise and bind acetylcholine, a messenger chemical released by nerve cells. The presence of the antibodies prevents the muscle receptors from "seeing" the acetylcholine and also reduces the number of receptors. Thus muscles do not move when they are supposed to.

Put simply, that is what goes wrong in MG. But important questions remain unanswered. Why is it that about one in 10 patients have no detectable antibody? Why are the antibodies made in the first place? How might MG be cured? (For about four years doctors have been able to give patients tremendous—but only temporary—improvement with a treatment called plasma exchange which removes the antibodies from their blood.) Why do levels of antibody in patients' blood sometimes drop when they regain muscle control, and sometimes not?

Past studies lead Newsom-Davis to believe that myasthenia gravis exists in at least three forms. One is associated with a tumour called a thymoma; removing

Lois Wingtonson

the tumour is obviously necessary but does not improve the myasthenia. In other patients, the thymus turns out large numbers of antibodies, and taking it out can help; the commonest group, primarily women younger than 40, have an overgrown thymus but no tumour. Removing the thymus can help such a patient, but seldom completely because antibodies are also made in the peripheral blood and lymphatic system. The third group is composed mainly of older men whose thymuses have atrophied.

Both of the last two groups is linked with a particular genetic fingerprint called an HLA type; one obvious conclusion is that these people inherited a predilection for some triggering factor—perhaps a virus—that causes them to begin reacting to their own muscle-cell receptors. In only one situation has a trigger been clearly identified. Newsom-

in culture, and of studying the lymphocytes made in the thymuses and blood of MG patients. His colleague Angela Vincent is studying the interaction of patients' antibodies with muscle cell receptor, hoping to determine how these antibodies differ from patient to patient.

A subset of lymphocytes, called B cells, are known to manufacture antibodies. But other lymphocytes called helper cells and suppressor cells (which come from the thymus) are necessary in the process. How do they all interact in blocking muscle action in MG? "We are still in the dark about that," says Newsom-Davis, but he hopes in time to have some answers.

Thanks to his new professorship, Newsom-Davis can now devote more of his efforts to solving the problem. Under the MRC's new Clinical Research Professorship Scheme, he has a research job for life. The MRC and the University of London are working together on the scheme which the MRC will review after five years—although once an appointment has been made its holder will keep it until retirement.

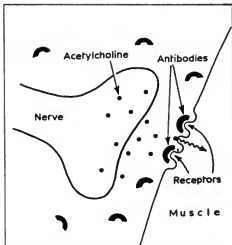
The MRC hopes the new professorships will turn out to be an investment in the future of medical research in the UK—encouraging new research teams to grow around promising medical scientists and allowing young doctors to consider medical research as an option for the future.

In certain medical fields, including neurology, there is practically no such option at the moment. Junior academic posts are rare. With cuts in the National Health Service the clinical load is increasing for non-academics, and extra time is vanishing. Research money is difficult to come by, and salaries for academic posts are usually lower than those of consultants or doctors in private practice.

With all these disincentives, Newsom-Davis says he fears for the future of clinical research in the UK. "There are not all that many doctors committed to doing research," he says, and he hopes his new appointment and others like it "might enable them to see there is some future in it".

The second recipient of a Clinical Research Professorship has not yet been named. Naturally any doctor who intends to truncate his clinical works needs goodwill from his colleagues; thus the MRC requires that the university dean applies for the Clinical Research Professorship on behalf of a researcher. On his own the researcher must demonstrate his ability to attract separate funding to pay his research and buy supplies.

The professorships are unusual in focusing on a scientist's plans for the future, rather than his past accomplishments (which must, of course, be promising in any case). By supporting scientists such as Newsom-Davis, the MRC is rewarding excellence and building a small bulwark against the erosion of clinical science. □



The antibodies (semicircles in the diagram) present in some people with MG block the receptors on muscle cells, and prevent acetylcholine molecules from transmitting the signal for muscle movement

Davis and others have found the antibodies in patients who developed MG after taking the drug *d*-penicillamine for their arthritis. Once they stopped taking the drug, their symptoms improved—and the antibody level dropped.

But why the drug can cause MG, or what triggers the disease in other people (who are fortunately rare—about one in every 30 000 people) are still open questions. Newsom-Davis hopes the answer will evolve from studies of the antibody-forming cells, the lymphocytes. There are several different types of lymphocytes circulating in the blood, and lymphocytes also occupy the thymus in great numbers. In fact, the thymus seems to be the site where lymphocytes learn what is "self" and what is foreign. Where do they go wrong?

With the help of Nick Willcox, an immunologist, Newsom-Davis has developed ways of growing thymus cells

free university amsterdam

centennial congress:
CONCERN ABOUT SCIENCE
October 13-17, 1980, Amsterdam.

The Free University, founded in 1880 as a private Reformed institution free from church or state control, will celebrate its first centennial by organizing an academic congress on the general theme "Concern about Science". This wide range theme comprises first the problem of how values inherent in the scientific enterprise can be maintained; and second the problem of the conditions that determine whether science will have a beneficial influence in a society.

Three subthemes will be discussed:

- The relationship between scientific knowledge and other types of knowledge, such as religious knowledge;
- Ethics and Science; basic to this subtheme is the assumption that science is never value-free and that scientists have heavy ethical responsibilities;
- Science in society; possibilities and boundaries for priorities and control.

Speakers at the congress will be from Third World, Eastern and Western countries. Contributions are invited. Those wishing to present papers should submit abstracts before August 1, 1980.

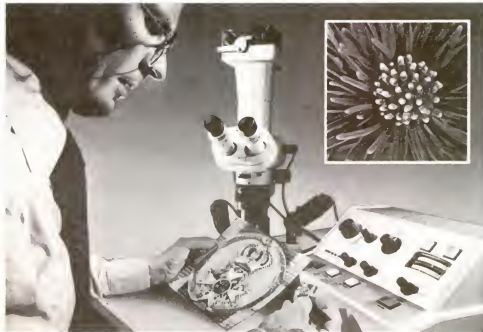
Scholars from Third World countries who would like to attend the congress may be eligible for financial support for their travel and accommodation expenses.

Further information is available from Bureau Rector Magnificus, Vrije Universiteit, "Concern about Science", postbus 7161, 1007 MC Amsterdam, the Netherlands.

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Technology

UK out of joint in laser welding

Britain is slipping behind other countries in applying an important new technology—laser welding—even though the technique has been under development in the UK for the past decade. Only one company in the UK—a small firm in Stockton-on-Tees—is using laser welding in a factory. Meanwhile, laboratories in the US, Japan and Italy are installing expensive equipment as a prelude to establishing the technique commercially.

In laser welding, a high-energy beam is piped from a central laser to the pieces of metal that have to be fused together. The process offers several advantages over conventional welding technologies, where the heat to bring about fusion is supplied, for instance, by an electric arc struck between the two pieces of metal or by electron beams. A laser concentrates its heat over a very small zone: metal 5 mm away from where the beam falls is unaffected. Thus laser welding produces minimal distortion, does not use much energy and is quick (little time is needed to cool the finished piece of metal after it has been welded).

The chief advantage over electron-beam welding, which is laser welding's biggest rival in high-accuracy work, is that the latter is a far less cumbersome process. In electron-beam welding, the pieces of metal to be joined must be placed in a vacuum chamber before the process starts. This is so that the electrons travel toward the metal unhindered by air molecules. This means that electron-beam welding takes a long time if a lot of standard components have to be welded—workers must constantly adjust vacuum apparatus and vary components to and fro between the vacuum chamber and the factory floor.

A further benefit is that a central laser can supply beams along a series of pipes to several work stations: while workers are setting up two components to be welded at one station, the laser could be fusing together two other parts at a separate station. There is therefore no need to turn the laser off while parts are set up, or to leave it on while it is not in operation and so waste energy.

According to Claude Eastes, a British engineer who is advising Fiat, the Italian car firm, laser welding with several work stations is the most efficient way to apply the technology. Fiat is experimenting with a £500 000 15 kW laser at its research laboratories near Turin. The company plans to put laser welding equipment in its factories within the next year or so.

In the UK, the Welding Institute in Cambridge started research on laser welding in 1969. In 1975, the institute licensed its technology to a subsidiary of the British company BOC. Three months ago, BOC sold its stake in this company to the American company Control Laser. Since 1975, the Daventry-based firm, which is now called Control Laser Ltd Industrial Power Beams, has

sold 17 lasers for welding, nearly all overseas. According to Richard Ashcroft, the firm's engineering manager, "British industry is generally not keen to go for new processes."

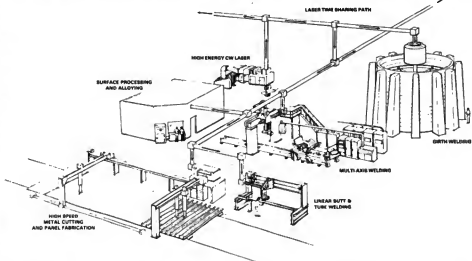
Earlier this year, the Welding Institute licensed its laser technology to a second firm, the Osaka Transformer Company of Japan. Hitachi, it is thought, is about to sell laser-welding equipment based on British-devised technology.

In the US, the Naval Research Laboratory is to build a high-speed laser welding plant in Minneapolis (see diagram). The welding will be carried out under computer control in an automated facility where parts pass to the welding area from numerically-controlled (NC) machine tools. According to the laboratory, the new technique can increase welding speeds tenfold, and reduce a

factory's dependence on labour-intensive manual welding.

The single factory in the UK which has a laser welding facility is run by a small firm, Expert Heat Treatments in Stockton. Since January, the firm has welded parts for hydraulic equipment with the new technique. It finds that the welds take only 3 to 4 seconds, whereas with conventional welding the time was 20 seconds.

Most lasers used for welding must be fairly powerful, in the 2-5 kW region (in cutting applications, where lasers are far better established, a beam of less than 1 kW is needed). Laser-welding apparatus is not cheap: a 2 kW laser with the necessary fixtures for welding costs about £70 000, while an electron-beam welder that can do the same job, albeit more slowly, costs about £40 000. □



Engineers in the US will demonstrate the high speed advantages of laser welding

Easy listeners reject clipped tones

British audio engineers have shown that the apparent qualities of a loudspeaker can depend on the type of music played through it. This could explain why a hi-fi loudspeaker which performs well in a laboratory test may be heavily criticised by some reviewers and why the reverse can also happen.

In tests at Rank Wharfedale's factory in Bradford, engineers deliberately "clip" the signal fed to the loudspeaker—this means that the smooth peaks of the waveform are abruptly squared off. This normally occurs unintentionally when a hi-fi system is overloaded; for example, when the volume is too high.

Some music, such as disco pop, is so undemanding that a listener will fail to notice clipping during 5 per cent or more of the time the music is playing. But clipping during classical music—especially piano works—is noticeable even when it happens less than 1 per cent of the time. The phenomenon is also much less noticeable when the music is

played loudly; up to 15 per cent of clipping on pop and 5 per cent on classical passes unnoticed. This is because distortion inside the human ear masks the electronic defects of the system. The same is true of resonances caused by reflections inside the loudspeaker cabinet. These add and subtract sound to produce peaks or dips in the frequency response (so called "coloration" of the sound).

Wharfedale's engineers have built electronic circuitry which enables them to mix a controlled amount of synthesised coloration with a cleanly reproduced sound. High levels of coloration can pass unnoticed when mixed with some music but are glaringly obvious with other music. Particularly confusing is Wharfedale's discovery that most listeners actually prefer the sound of a dip in the frequency response to a perfectly flat response, even though the latter is a more accurate reproduction of sound. □

Proposals constructed to save lives

Engineers at the Cranfield Institute of Technology have completed a research programme which could help to prevent coach accidents turning into tragedies. Guy Tidbury and his team from the institute's School of Automotive Studies have presented the UK Department of Transport with design changes which should overcome the problem of collapsing coach roofs—the major killer in “roll-over” accidents.

Although it is seven times more dangerous to travel by car rather than by coach (according to DoT statistics based on user accidents per kilometre travelled), many more people can be killed and injured in a single vehicle accident when a coach is involved. For example, 31 old age pensioners were killed when their coach overturned at Dibbles Bridge, West Yorkshire, in 1975. This was one of 26 accidents throughout the UK that the Cranfield workers investi-

gated during the study; the Bedfordshire-based team would often travel hundreds of kilometres to the scene of an accident on hearing of it on a news bulletin.

Most deaths in coach accidents are not caused by the initial impact. The sequence of events in such a disaster is often as follows: brake failure or excessive braking puts the coach into a sideways skid; the coach begins to roll until the rail where its roof meets the vehicle side hits the ground; this rail acts as a pivot and flips the coach over so that the roof and one side are forced inwards.

Although many casualties are thrown through windows, by far the largest number of deaths happens, says Tidbury, when people are crushed between seats and the collapsing coach structure. In many cases, the most serious part of the accident comes when the coach has lost all forward momentum and falls only a few feet below the road surface.

The Cranfield team set up a ramp at the Motor Industry Research Association's site and slid a specially strength-

ened coach down it. When the coach hit a kerbstone at the bottom of the ramp, it would overturn in the same way that it would in an accident.

Data from these tests coincided almost exactly with a mathematical model which the team had previously developed. The basis of the “theoretical accident” was CRASH-D, a computer program which predicts the behaviour of a structure under dynamic stress by a technique called finite element analysis. High-speed cameras filmed the way that dummies were thrown around inside the coach during tests—the first time such information had been taken from a coach roll-over.

The Cranfield recommendations include a tubular steel cage structure which would make the collapse of a coach's panels less likely. The teams proposals will form the basis of a regulation from the Department of Transport—it will set minimum standards for the structural strength of all coaches and buses in the UK. The DoT will also take these proposals to a meeting of the Economic Commission for Europe, a UN body which has a committee examining road safety proposals. DoT officials will propose that authorities throughout Europe should also adopt similar standards of coach safety. □



Information from real accidents (left) or experiments at Cranfield could make coach travel safer

Car maker could suffer a major reverse

Bad parking habits could be the major reason for a rash of bizarre accidents involving 6000 Ford cars in the US in recent years. Marcus Jacobson, chief engineer of the Automobile Association, told *New Scientist* recently that a car fitted with one of Ford's automatic transmission systems and repeatedly parked unattended with its engine running could eventually set off on its own, in reverse. Whether or not it is the drivers who are to blame, such incidents have led to 98 deaths and Ford must face a hearing to be held by the Department of Transportation in Washington on 21 July. This could lead to the recall of 16 million cars and trucks.

The problem is peculiar to the US, says Jacobson, for several reasons: the arrangement of the driver's controls is quite different from the layout of a European car; it is illegal in, say, the UK to leave a car unattended with its engine running; and the C-3 automatic transmis-

sion fitted to the Ford Escort and other models in Europe is different in several features of its construction from the American equivalent—the type of linkage used is not likely to wear in the same way.

Most cars in the US are fitted with air conditioning and heating to combat greater extremes of temperature than most European countries face. To ensure that their cars do not stall every time they brake, American drivers leave their cars to “warm up” with their engines running and the transmission set to “park” in the winter. Alternatively, to avoid uncomfortably high temperatures inside the car at the height of summer, drivers will also park with the air-conditioning, and therefore the engine, running.

Because cars in the US are designed with a front “bench” seat, the controls must be fitted to the steering column or on the floor in front of the driver. Legis-

lation says that a car's parking brake must be fitted to the floor. In most cars, this control is so awkwardly placed that drivers do not bother to apply it when they leave their cars.

If a car is badly maintained the linkages which connect the gear selector to the gear box begin to wear, says Jacobson. Also, as the car's transmission oil gets hot, which it does when its engine is idling, it becomes thinner and can leak past the valve which holds the automatic transmission in its selected position. A combination of these factors can lead to the car's gear selector slipping from “park” to “drive” or “reverse”. Unfortunately for Ford, its cars tend to slip into “reverse” quite easily. This has led to accidents in which, for instance, a driver has slammed his car's boot lid and the car has run him down.

Although Ford is naturally keen to point out the ways that Americans mistreat their cars, it may still face a very large bill that it can ill afford in the wake of current high losses. □

Technology

continued

Video trump card stays under the table

Thorn-EMI recently demonstrated the JVC video and digital audio disc system (VHD/AHD) which the company decided to adopt in April. The demonstration confirmed that VHD/AHD can produce good quality colour TV pictures and stereo sound in video format. It also produces accurate, high-fidelity sound from digital audio signals. However, engineers from JVC in Japan who demonstrated the system used concealed equipment to disguise a drawback in VHD—its poor reproduction of stills by the "freeze frame" technique. Freeze Frame—a technique which allows the user to hold a single

"still" frame—would be an important aid to demonstrators in industry and education.

According to JVC: "dust and bumps are a worry of the past with VHD." The company claims that, although its video discs should always be housed in a plastic caddy which will cost almost as much as the disc to produce, the electrode stylus will sweep aside any amount of dust from the disc's surface and will break off surface "flash". But JVC provides no information on how the player will cope with the surface pits which are a more common fault in video discs.



VHD/AHD, the video and audio digital recorder from JVC, showed remarkable powers of reproduction at a recent demonstration

This type of fault is not easy to control because tracks on the disc are only 1-35 micrometres apart—about one-fiftieth of the diameter of a human hair. The pictures shown at Thorn-EMI's demonstration were free from such "drop-out" blemishes. But the soundtrack buzzed audibly. This indicated that a drop-out compensator—a powerful device which can hide picture defects—was operating.

Thorn-EMI is to invest over £10 million in new machinery to manufacture VHD/AHD discs in Europe so the company may soon be able to answer questions on disc pressing tolerances from first-hand experience.

The VHD disc is 26 cm in diameter and, for European TV standards, will rotate at 750 revs per minute. To hold one hour of programme material on each side of such a small disc, it must record 2 TV picture frames during each revolution. For freeze frame, the stylus electrode stops over a single track to read a repeated sequence of information. When the picture contains movement, the still frame on screen is blurred. But when the Japanese engineers demonstrated freeze frame to the UK press the pictures were perfect. They said that the still pictures were displayed from a specially encoded passage of the disc in which two identical frames were recorded during each revolution.

Although this recording technique gives perfect still pictures, it produces unacceptably jerky motion on most material at normal playing speed and halves the amount of information the disc can store. The JVC engineers then demonstrated an equally perfect still picture from normal programme material, explaining that it was the result of "a special processing circuit" which could be provided in the player.

Normally a solid state memory with ▶

Turbo-charged locos steam into view

Dr John Sharpe, a research engineer at Queen Mary College, London, believes that rising oil prices will lead to the return of steam locomotives in many parts of the world. Sharpe recently visited China in response to strong interest shown in a radical design for a steam locomotive that he has introduced. He also reports strong interest from rail authorities in Argentina, Australia and the US.

Sharpe's locomotive differs from conventional designs in several respects. It will burn very low grade fuel—sulphurous coal, containing up to 30 per cent ash, the lowest grade of oil (known as bunker fuel), logs, wood chippings, even fuel made from machine-sorted refuse—without causing pollution. This it does by burning fuel in two stages in a furnace incorporating a fluidised bed. In the first stage, the solid fuel particles forming the fluidised bed are partially burned. In the second stage part of the upward current of hot air passing through the bed is diverted upwards into a cyclone. Here, unburned fuel is con-

sumed in the form of gases from the fluidised bed's exhaust.

The cost of supplying high-quality water for the boiler will be high, especially in arid mining areas where the locomotive is expected to make its debut. Sharpe has designed a system where steam will be recycled continuously. Another innovation will be the first turbocharger to be built into a steam locomotive: some of the high-pressure steam from the boiler will be diverted to drive a turbine; this will in turn compress more steam to still higher pressures before it goes on to drive the pistons.

Sharpe says that he is confident that his calculations of the cost effectiveness of the design are accurate. He defines cost effectiveness in this case as the product of the locomotive's horsepower multiplied by its operating efficiency and divided by the costs of its fuel. Although modern diesel locomotives are efficient operators, steam locomotives burn cheap fuel. These two factors cancel each other out. But by greatly increasing horse-

power and operating efficiency while burning low-cost fuel, Sharpe says that his design can be five times as efficient as that of the best traditional steam locomotives or diesels and "considerably better" than that for any other new steam locomotive design.

Rail authorities think that, in general, electrification is the best economic alternative for short- and medium-distance railways carrying both freight and passengers, and for long-distance railways with heavy passenger traffic. But for long- and perhaps medium-distance work on lines with intensive freight traffic and little or no passenger potential, steam is the most economical motive power.

For long-distance heavy ore trains, says Sharpe, the advantages of steam now seem inescapable. He thinks that his design might, eventually have a future in the UK on lines where electrification is especially uneconomic and where there is plenty of freight traffic. But his blueprint is likely to become reality in Australia and Argentina long before there is any revival of steam on British Rail. □

► 2 Megabits capacity is needed to freeze a TV picture frame and display it as a continuous picture. Such units currently cost about £10 000 and are the size of a small suitcase but the JVC engineers refused to discuss the nature or cost of the circuit which was freezing the still picture on a compact VHD player (Thorn-EMI plans to sell the player at under £300).

After the conference, bulky solid state frame stores were found hidden under the table on which the player was being demonstrated.

● Sony and Philips have announced that they will join forces to sell digital audio



discs in the UK. They will launch Philips's Compact Disc—at 12 cm this is slightly larger than was originally proposed—during 1982. Discs will be made at Philips's Blackburn factory. □

Word processor puts finger on bad spellers

The good news for bad spellers is that computers can now help to correct their errors. The first product from a new company in the UK automatically attempts to correct misspelt words; in the US, IBM has introduced a word processor which can identify—but not change—bad spelling.

The British system, Corrector, checks typed-in words against a computerised store of 25 000 words taken from the *Oxford English Dictionary* and up to 20 000 additional words that can be specified by the typist. If an operator types a word that is not part of the

machine's vocabulary, Corrector searches for a word in its dictionary which is spelt in a similar way but with a slight variation. If the operator types in "mathc", the computer might come up with "match".

Corrector produces a list when it has checked a given text. The list identifies those words which have been altered (together with the original spelling) and the words which do not correspond to any word in its own dictionary.

The typist can then alter any words still misspelt or change words altered incorrectly by Corrector. If a word is spelt

correctly but is not in the machine's dictionary, the typist can add the word to the dictionary.

Corrector's software package was developed by Southdata Ltd, initially on a Research Machines 380Z microcomputer. It will be made available to owners of this and other computers for £150 to £200 and also to manufacturers of word processors to incorporate in their products.

Corrector can check text either after a certain amount of text has been typed, such as that filling the display screen of a word processor, or directly after each word is typed.

IBM's Displaywriter consists of a display screen and keyboard and costs about £3400 plus £6.50 each month for hire of the software which runs the system.

After a screen has been filled, a typist can indicate that the spelling needs to be checked and the misspelt words are highlighted on the screen. The typist then corrects the necessary words without the need to search out errors.

The Displaywriter has a dictionary of 50 000 common words and space for another 500 which can be added by the typist. Unlike Corrector, however, it makes no attempt to find the correct spelling.

Displaywriter is not available in the UK at present. □



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Slaughter of the elephants

Elephants are being butchered in Central African Republic but the government has neither the will nor the means to halt the killing

Monique Borgerhoff Mulder
and
Tim Caro
have just driven
through Africa

such a gloomy forecast is likely to come true. Elephants in CAR are exploited in three distinct ways: through commercial hunting ventures, through organised poaching with tacit encouragement by the official establishment, and through increasingly effective hunting by locals.

The Central African Republic is a huge landlocked territory of 617 000 square kilometres that lies across the breadth of Africa. It consists largely of forest and bush and has a sparse population of approximately 2 million people. Because two-thirds of the country is uninhabited, rather than because of government policy, the wildlife is believed to be protected. In the south-west and centre of the country small groups of villagers regularly hunt for food with spears, nets and bows and arrows, but in the northern and eastern regions (where the people were farmers) elephant, buffalo, antelope and carnivores inhabit the vast tracts of guinea-savanna woodland in numbers reminiscent of East Africa in the 1920s. However, the lack of a forward-looking political force and the inaccessibility of much of this region have produced condi-



The main street of Zemio on the M'Bomou. (See map below)

tions under which an ivory trade of enormous proportions is flourishing.

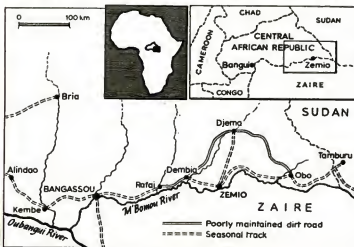
Zemio is a town on the M'Bomou River in the heart of this eastern district; it is the centre of ivory operations between Rafai and the Sudanese border. According to official figures 147 tonnes of ivory, roughly equivalent to tusks from 15 000 elephants, left the region last year. At a rough estimate the population of elephants in this area has dwindled from 50 000 to less than 10 000 in the past five years.

Commercial hunting organisations take many forms, from overnight entrepreneurial partnerships to large-scale international consortia. Companies and individuals can buy blocks of hunting land 100 km x 100 km from officials in the capital, Bangui. Frequently people get two or three adjacent blocks to increase the area available for hunting during the short dry season—heavy rains make tracks impassable from July to December. Block owners are mainly French, Spanish and Portuguese, mostly colonials, and their businesses are often allied to diamond enter-

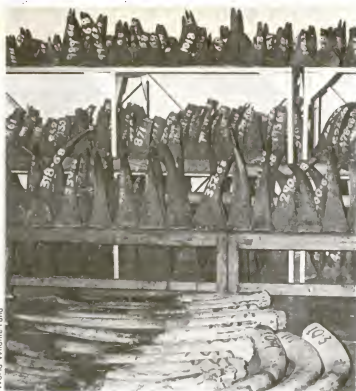
prises based in the west of the Republic. Clients are usually from France, the US and Japan and have to be wealthy; expenses run to \$10 000 per fortnight as provisions at encampments are luxurious and must be brought in by air. Clients must also buy a year's licence in Bangui which allows them to bag one of every species except buffalo—each gun can shoot three of these. No one is present to enforce these quotas except the hunters themselves. Clients also pay for animals—a hartebeest costs \$300, an elephant \$800.



The traditional hunter has his net, spear and club for catching monkeys



World Wildlife Fund



Ivory, whether taken by poachers, right, or gentlemen in 1892, below, ends up in trade, like these tusks in a Mombasa warehouse, left



All this revenue eventually finds its way into government coffers; rich Europeans are actively encouraged to visit CAR and its popularity has increased since Kenya closed its borders to hunters. Men such as Giscard D'Estaing and his friends are regular visitors to one of the 10 or so encampments in the east of the country.

Less official but no less effective are the Arab poachers. Arab traders and shopkeepers own almost all the vehicles outside Bangui and are therefore in an excellent position to buy ivory and to transfer it out of the country to Europe and the Far East. Ivory operations no longer consist of swift poaching raids across the border but are on a huge scale; traders now obtain entry and exit permits for their ivory-carrying trucks.

One consequence of this is that local villagers, traditionally agriculturalists who do not hunt, have become aware of the market for ivory and are turning to full-time hunting as a career. They manufacture guns from anything available—Land-Rover steering-track rods are exactly 12 bore in diameter—or buy them directly from Arab dealers, and then burn large tracts of forest to flush out elephants.



Mary Evans

In addition, villagers have taken to selling ivory amulets and elephant hair bracelets openly on the roadside.

The final and far the most serious threat to the elephants is the official establishment. Hugely powerful local police chiefs and administrators manage to turn both hunting and poaching to their personal advantage. This must be seen in its historical context. During the 13 years of Emperor Bokassa's dictatorship the country, which the French left administratively, economically and educationally unprepared for independence, fell into ruin. Bangui became a political island from which the emperor could ravage the country by commandeering any vehicle he wished. Bokassa's greed for ivory is well-known, and he sent tusks directly to France through an as yet unidentified French lady. After the coup in August last year, the French handed Bangui over to President Dacko but the bush beyond Bangui was left in the hands of politically autonomous local administrators and police. Bokassa's henchmen were removed but otherwise events in the capital have had little impact on the rest of the country. The potential unaccountability of the local sub-prefect and his men is enhanced by the lack of an efficient communications network. Radio transmitters are held almost exclusively by the police and fuel for the generators is rarely available. The roads, which have been left to the encroachment of the bush for the past 14 years, have been eroded by torrential rain into steep ravines. It takes a heavily laden truck 4 to 5 days to cover the 1000 km of Route Nationale 2 from Bangui to Zemio—not allowing for unavoidable breakdowns on the rocky staircases.

Against this background police have unlimited freedom to enrich themselves with ivory and other spoils. They periodically raid the hunters' encampments and put their bush airstrips out of commission by placing logs across the runway. The foreign operators are either imprisoned or sent to Bangui while the police loot their arsenals. The hunters return after several months and continue operations, making payments to the police to prevent further interference.

Another police trick is randomly to enforce a law that



The ferry across the M'Bomou, where the ivory leaves the Republic. Officials confiscate ivory only if they haven't been bribed

no person may poach for meat. The police arrest able-bodied men from any household where meat is found in the cooking pot, and arm these "prisoners" with weapons taken from the hunters' armouries; the men are sent after ivory. A successful hunt provides ivory for the police who also sell the elephant meat back to the men—who run the risk of being re-arrested.

During January of this year these and other outrages led the Zande people of Zemio to besiege their police force in the sub-prefect's house. After several days military reinforcements came from Bangui and the police were recalled; but the new men in control have exactly the same power. The final irony is that control of the area known as "le forêt de Pluie", which stretches from Rafai to the Sudanese border, is the responsibility of these same corrupt local administrators whose job it is to see that there is no illegal, that is unpaid-for, ivory leaving the region. This "control" consists of one road barrier at the Rafai ferry. It is frequently unmanned. If the police do perform a search, they confiscate ivory, guns and ammunition which they later resell, unless a heavy bribe is paid.

We can't say whether hunters, Arabs or the administration are the gravest threat to the elephants. Local opinion sees the Arab operators as the greatest drain on the ivory, but this view may be coloured by resentment of the enormous wealth of these foreign entrepreneurs. Certainly 147 tonnes of ivory from the eastern part of CAR came over the Rafai ferry last year and most of this was Arab cargo. But although rich Arab dealers are undeniably able to evade controls and do play a significant part in the slaughter of elephants, poaching on the part of locals, who find they have no other way to earn the currency they need to buy their few necessities, is a growing problem. The road to Bangui is now so bad that wholesale buyers have begun to pull out of the region; coffee and tobacco lie rotting unsold by the roadside and will no longer be planted. Attempts to introduce rice as a cashcrop have been thwarted by

bilharzia-carrying snails in the water. And cattle die of sleeping sickness. Only a successful scheme of rural development that offers an alternative means of earning money will entice a local to give up lucrative poaching.

The hunters claim they are professional and that they follow strict conservationist principles in order to be able to reap animal trophies for many years. Although such rationalisation may be valid in some cases, real conservation strategies can be based only on a sound understanding of each species' particular social organisation and ecology. For example, the current limit of 20 kilos per tusk in the north and 40 kilos per tusk in the east are arbitrary figures that are not based on data. Many of the hunters are amateurs after a quick fortune, with no interest in conservation. In any case, political instability and the risk of arbitrary imprisonment in CAR do not make it worthwhile for even the professional hunter to pursue a policy oriented towards species replenishment. The business of hunting in the Central African Republic is shabby.

Short of far-reaching political change in that part of Africa, it will be difficult to prevent the annihilation of elephants in CAR. Tight control of the police is essential; perhaps President Dacko and his French military supporters can bring order to the administrative system. Because vast stretches of bush are uninhabited a comprehensive road network is a *sine qua non* of any viable patrol unit. This of course will take finance—of which Bangui has none. To establish and protect national parks properly will take high initial investment, but with the decline of wildlife in Kenya, its ebb in Uganda and the isolation of Tanzania, photographic safaris would undoubtedly provide a healthy market. Against this, we recognise that for poor governments in desperate need of money, ivory and big-game hunting provide hard cash quickly.

In the end, the world will have to curb its greed for ivory. Meanwhile, the only hope for the elephants in eastern CAR is to swim the M'Bomou River into Zaïre, where the ivory trade also flourishes. □



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The New Scientist Interview

Rod James

He is director of the National Centre for Alternative Technology: he is, therefore, one of the inspirators of our age. Next month he and his family will leave the centre. Here he speaks with Robin Clarke

ON 7 August, Rod James and his family will drive reluctantly away from a beautiful house on a Welsh mountain. They will leave behind something more than one of the best views in the world. For six long years James has nurtured the Quarry—as the NCAT is known locally—from what has often been described as “a bunch of freaks in the middle of Wales” into an internationally known and respected centre for alternative technology.

Today the Quarry shows 60 000 visitors a year round its exhibition. It displays every conceivable AT device, from solar panels to wind generators, from water wheels to woodstoves, from organic gardening and smallholding to appropriate building techniques. It holds weekend courses for enthusiasts, runs a huge bookshop, a restaurant, a natural food shop, a products centre and an inquiry service, and plays a growing and now significant role in planning AT strategy in the world at large. Its experts serve on the Intermediate Technology Development Group's specialist panels, lecture to the Institution of Electrical Engineers, are paid by the Energy Support Unit at the Quarry's Harwell to amplify study of Britain's alternative energy strategy, and generally earn a respect for their work that was unthinkable half a decade ago.

The centre was the brainchild of Gerard Morgan-Grenville, chairman of the Society for Environmental Improvement (SEI), a registered charity. In 1973 the Quarry was just a site which had been rented by the charity for a peppercorn rent of 5p a year. The site, in fact, was a disused slate quarry, a tangle of 20-year-old brambles, wrecked buildings and slate waste. In the first three months of its existence, the Almighty poured 150 cm of rain onto this mess. Half-a-dozen dirty and dripping unpaid volunteers picked their way mournfully from one makeshift shelter to the next.

In 1973 James bought a ruined house and barn—both a metre deep in cow muck—on the side of a mountain a few kilometres away. He had qualified as an architect a few years previously and now plans to run a small architectural practice for modernisation and conversion in the Machynlleth area, charging, as he put it, “about one-tenth of the RIBA standard fee”. In the same year the SEI rented the Quarry, and some of its volunteers began to wend their way up the mountain to seek James's help.

“One day I made a complete window frame for them, to show how the joints worked. They took it away and I went down there a week later to see how they were getting on. In that week everyone I'd talked to had left, and a completely new set of people were there. So I made another window frame.”

The AT path is rarely smooth. The Quarry opened to the public prematurely with nothing much more to display than “a few notices, saying this will be the site of a wind generator, a sign saying ‘worms are your friends’, a methane digester and a solar roof”. And the following winter a tidal wave swept down from the hills above, washing away the access road, destroying what little work had been done, and leaving even the precious files standing 30 cm deep in water. It was then that James was hired by the



SEI to act as the Quarry architect for a fee of £20 a week. Most of the other workers earned £5 a week.

Within three months James had been appointed the Quarry's first director, and Bob Todd, an extraordinarily versatile engineer from Southampton University, its technical director. Almost the first thing James did was to run a national ad, “Have you a month to spare?”, asking for volunteer work. He got it—in copious quantities. The wrecked cottages on the site began to be transformed into reasonable living accommodation, with solar heating and woodstoves. They opened to the public again, and the following summer they built a huge exhibition centre, with offices above, from the wrecked slate cutter's workshop.

‘The movement ties itself in knots trying to justify its conviction that an electric drill is OK but a Kenwood mixer is middle class and wasteful ...’

In two years the Quarry acquired tremendous momentum. Vast projects were undertaken, volunteers poured in, buildings were put up, money was raised and the place began to look like a going concern. The visitors began to arrive, starting at 15 000 a year and then going up by 10 000 every year. Special projects were undertaken with grants from the Welsh Tourist Board and, with the help of the Manpower Commission Scheme, need-based salaries went up from pittance level to the current rate of £2500 for a single person, and £3500 upwards for a couple with children. Today between 20 and 30 people work there full time, plus about five volunteers, and the place supports a total of 50 people, including spouses and children. Originally the SEI had raised £40 000 for the project, and spent £15 000 of it exploring what to do. Now the Quarry's turnover is nearly £200 000 a year, and it is paying back 5 per cent of its takings to the SEI every year, to support new ventures.

James is happy about the place's success but wonders ruefully where it will lead. “In the early days we did so much with so little we had little enough time to plan or debate the finer issues of our progress. Today, with much



Sixty thousand people visit the Quarry each year: to see fine technologies; and to see how many plants may grow in one small space ...

Tom Reynolds

James explodes with fury while reading the handout of a new AT venture. "We believe," it reads, "that education is not achieved primarily at school but continues throughout life."

"Did you ever see anything so trite? Of course it does. You might just as well say we have to eat throughout life. Until AT weans itself off this highly self-righteous path, we'll never get anywhere. We have to have specialists—specialists who can promote our aims to the general public, not by telling them they're wrong but by presenting the AT

more money to spend, we have to think more carefully, plan more critically. Our own form of bureaucracy has come to stay. Now we even have to have project application forms for those with new ideas!"

Personality cults are invidious in the AT movement, but 10 minutes with James leaves little doubt as to why the Quarry has hung together so well. He has a special kind of charisma, a bright-eyed, quick-witted energy with just a hint of the public school and an infectious enthusiasm tempered with just a touch of cynicism. Naturally enough, he is an alternative technology enthusiast, and a severe critic of the nuclear industry. "The best that can be said of that is that it is an unfriendly technology." But his acceptance of the AT world is by no means universal nor uncritical.

"So much of AT is so precious. The movement itself has so often been preoccupied with telling everyone else they are wrong. It ties itself in knots trying to justify its own inner conviction that using an electric drill is OK but using a Kenwood mixer is middle class and energy wasteful. That kind of argument has always driven me to distraction."

backdrop in a human way, pointing out that alternatives do exist, and we are just one of the groups trying to explore them."

I have visited the Quarry every year since it began. Always I have been aware of that slightly self-righteous air of virtue which James complains about. Even today, a small notice half-way up the track to the exhibition proclaims "We do not think your lifestyle is wrong". If that were true, there would of course be no need to say it. And every visitor to the Quarry must be aware of the tensions that exist between a place which is on one hand a public exhibition and on the other an experimental community or, as the centre would have you believe, "the village of the future".

To hold such a place together, never mind making it grow, is no small achievement. How is it, then, that a director with extremely clear views on what he wants has not stamped his personality more brutally on the Quarry's public face? In the alternative movement, democracy—even at its most ridiculous levels—is probably held more

sacrosanct than any other tenet of belief about the environment, wholefood or energy waste. Though the Quarry is not technically a cooperative under the terms in which it was set up, it believes itself to be so, and adheres passionately to its right to pretend it is. Thus James has been a director, with the statutory authority but with an often dissident work force to direct.

To help solve the problem, he instigated the Monday meeting which everyone attends. He made his own stance clear; the place would work neither as a co-op nor necessarily according to the statutes. More simply, James told the Quarry, there had to be trust between the SEI and him, and then more trust between him and the Quarry community. If that were achieved, they could operate how they liked and anything was possible. And it's clear James has exercised his real authority only on a handful of occasions. He has let himself be over-ruled often. And has always been ready to listen, more or less to whatever anyone had to say.

Despite that, James is not at heart a believer in group solutions to all problems. "I personally prefer to work on my own, and find that most other people do too. In fact, most of our big projects have not been conceived at group meetings; they happen when a couple of people start chatting in a far corner of the site. What happens at group meetings is that people air their grievances. More often there is silence. People don't say what they feel in a group. Much more likely they say what they feel behind a windmill after lunch. It is a situation which may change with time but you can't just expect group discussion to lead directly to decision making responsibility: it must grow."

A good deal of James's time at the Quarry has inevitably been in sorting out what he calls minor issues—"do we have brown sugar on the table, or white, or white and brown, or brown only and white on offer if requested?" But he acknowledges the importance of such things to the AT movement, even though he regrets it. In setting up the new products shop—which sells beer kits, wooden rakes, anemometers and a whole range of small goods marginally connected with AT—he has had to steer every new item through a Monday meeting of the whole staff.

"There are perhaps two things they don't like. One is overt commercialism, the other flashy packaging. And the packaging issue is extraordinarily paradoxical. For five years I've run a constant battle to improve the packaging of the Quarry. We are a public centre, we have to exhibit, and sometimes our whole purpose has been in danger of being submerged by sloppy thinking and poor presentation."

"It's a fact that until recently we've had quite a freaky image. When the public arrives and sees a long-haired lout standing at the Centre, they'd like to think he was half-crazed with dope, and slept with everyone on the site. Although it's not true, we can do only two things. Either we dress our staff up in suits and hope they say the right things. Or we hire people who are so enthusiastic about their work that as soon as they open their mouths their dress doesn't matter."

Because of this James has always insisted that standards at the Quarry must be as high as, or better than, those in establishment groups. "If we run a restaurant, we must serve good food, on time, and on clean plates. Nothing less will do." James carries the logic of his argument much wider too. If he had his way, the AT movement would hire "a QC or a Robin Day to present AT arguments to the public. Even our best PR people are no match for Walter Marshall. Every time we put one up against him on TV, they'll end up as mincemeat, not because they don't know the facts, just because they haven't got the public presentation side sorted out."

Nevertheless, in the past few years the Quarry has

"touched at least a quarter of a million people. Many of them have left the Quarry with their ideas changed, their image of the place—and hence of AT—improved. There is no doubt we have become the AT centre in this country, and now the establishment comes to us for help or advice on matters relating to our expertise. If I had to single out our most important achievement, it is that we have made AT respectable. We have built the bridge between those who believe in a more appropriate technology, and those who don't. During the 1980s we have to cross it."

Why, then, is James leaving now? Partly because for the time being he has had his fill of detailed group discussion on AT, which often leaves too little time with his family. He wants to continue to implement what he believes in, to make accessible to the general public what he and the group at NCAT have spent six years demonstrating. "At the personal level, my time here has been immensely rewarding—working with people I like, in a team which has produced exciting results." But James also likens his experience to that of a parent saddled with a permanently adolescent child—spots and all. "Normally it's a process that passes with time. But at the Quarry, with a constant influx of new people, we have to go all through all the old arguments every year. It's important that we do, but it's not important that I'm the person who should direct the day-to-day arguments. New approaches are the lifeblood of any group, and the group at the Quarry includes some of the most committed and above all human people I have ever worked with. Splitting up simply spreads the ideas further afield."

... just a hint of the public school and an infectious enthusiasm tempered with just a touch of cynicism... his acceptance of the AT world is by no means universal nor uncritical



In fact, his move away from the Quarry is a separation, not a divorce. James will remain the SEI Quarry man, but not the on-site director; he will also be the SEI link with the new Centre for Urban Appropriate Technology now being planned in Bristol.

He is certainly leaving at a time when the Quarry is well placed for its next great leap forward. They have just finished building the new restaurant premises, a lecture hall to seat 250 people and a large new exhibition. There is now excellent accommodation for visitors, good office space, an attractive reception area. Its weekend courses are usually overbooked and, in James's words, "the experts recognise us as a centre in our own right. The universities see us as a useful place to do research. Industry wants to exhibit equipment here. No longer are we a bunch of freaks in the middle of Wales." □

Review

Time for a major overhaul

The decline of the British motor industry

by Peter J. S. Dunnett, Croom Helm, pp 201, £10-95

The cash losses sustained over the past few years by British Leyland and Chrysler (now Talbot) have convinced people that the UK's car industry has only recently run into problems. This masterly book demonstrates that this is not the case. With an admirable economy of style, the volume traces events in the industry from 1945 to the present, showing that throughout the period almost everybody involved—government, the companies and (sometimes) the unions—got just about everything wrong.

After the Second World War the government used export quotas to direct the car firms to sell more of their goods abroad. British manufacturers went about this half-heartedly, however, and the export effort never really came off. It also made the firms complacent, thinking that there was a massive home market to sell to once the export drive was over. When in 1952 the export quotas were removed, the car firms sat back waiting for the rush from British people who had been starved of cars for so long. The rush never came

—demand was much less than anticipated—and the car firms were left with egg on their faces.

Later, similar miscalculations were the order of the day. Government "stop-go" policies in the 1950s and 1960s harmed the industry enormously as, almost as soon as car makers had geared themselves to expand during a "go" period, the government (by implementing credit controls and other demand-reducing tactics) applied the economic brakes to reduce the balance of payments deficit caused by trying to "go" for growth too strongly.

For much of the time after the war, there were too many British-based motor producers selling too many models in the face of increasing competition from abroad. Rationalisation—in the shape of mergers that led to the formation of the British Motor Corporation in 1952 and British Leyland in 1968—came too late. Furthermore, the establishment of BL came about only after a lot of pressure from the government; the antagonism displayed then by BL's component firms took



a long time to evaporate. Technical development suffered throughout the period as a result of the British industry's poor commercial results. Too little money was ploughed into new designs, or new manufacturing equipment. This led to a vicious circle of spiralling productivity and a failure to compete with emerging car industries from the developing world. During the 1970s, the situation worsened. As Peter Dunnett points out, it was foolish to imagine that, at a time of decreased world demand but stiffer competition, the "big three" US car firms (GM, Ford and Chrysler) plus

British Leyland could all run plants in Britain. Yet the UK government (for short-term political reasons) insisted on shoring up two of these firms (Chrysler and BL) when they were about to go out of business. Today, there is not the slightest hint that official policy has changed.

Not just students of the car industry should be interested in this book. It provides a well-reasoned account of the interactions between government and a major industry which anyone concerned with Britain's post-war industrial decline should find valuable.

Peter Marsh

A choice of catastrophes

by Isaac Asimov

Hutchinson, pp 365, £6-95

This is Isaac Asimov's shopping-basket tour around the shelves of some apocalyptic supermarket. It is a pot-pourri of cataclysm; a run through all the plots that end the end.

Asimov writes books like other people breathe—effortlessly. His nonchalant style sometimes lays so far back as to fall asleep ("the earth's interior is ravenously hot"). Having annotated Shakespeare, written a biographical encyclopedia of science, and played with the stars in both fact and fiction, it is natural that he should come to the end—in passing that is. Beyond the end of this book Isaac Asimov's face beams out from the inside dust-jacket. He is pleased with himself, as well he might be. His science is good, he can write, and *A Choice of Catastrophes* is popular mind-broadening doom. Writing as he does from a position slightly dis-

tanced from the human race it is perhaps unsurprising that he is buoyantly optimistic, even chirpy, about it all.

Asimov categorises the end into five classes, that in descending order of magnitude run: (1) an uninhabitable Universe; (2) The Sun misbehaves; (3) The Earth misbehaves; (4) Human life is selectively destroyed; (5) Civilisation collapses. Exciting stuff, but the prose threads its reassuring way around all the disasters turning them into something as harmless as knitting or croquet. Apocalyptic literature has never been cosier: the Moon is not about to descend on Croydon, the dolphins are not about to take over the merchant shipping fleets. He even finds reassurance in adversity: come the next ice age the drop in sea level will open up the continental shelf for real estate. Asimov's serious function is, however, as an antidote to all those books that concentrate on a particular variety of apocalypse and that do aim to engender a satisfying panic.

And yet through being rational and scientific he rather ruins the genre's hysteria. As there is "A Choice . . .", my favourite catastrophe is collision with a massive extragalactic anti-matter blanchmange.

Robert Muir Wood

Chemical victims

by Richard Mackarness

Pan, pp 203, £0-95

Medicine, more than any other science (or art or whatever it is), is plagued by eccentricities. Their distinguishing features are immodesty ("my theory explains every illness that besets mankind"), fixation ("every illness is somehow related to my theory"), a suspension of critical faculties ("the gaps in the theory aren't important"), and a keen sense of martyrdom ("of course, none of the establishment will listen to me"). Sadly, Richard Mackarness, the most articulate spokesman for clinical ecology, has written a book that displays all these charac-

teristics in abundance. And yet, the theory of clinical ecology is disturbingly convincing—I can't help feeling that Mackarness and his colleagues may perhaps be on to something.

The central dogma of clinical ecology is that as pollution of our environment grows, so more and more of us are becoming ill in mysterious ways attributable to an inability to adapt and stay healthy in the face of increasing chemical contamination. It is impossible to disagree with such a general proposition. But when Mackarness and the clinical ecologists express their theories more concretely, there is ample room for dissent. For they believe that the physiological mechanism that explains this failure to adapt is rooted in the biochemistry of the allergic response. As Mackarness says, "allergy has surpassed infection as the number one cause of human ills".

It is at this point in the argument that the weaknesses in the clinical ecologists' ideas

Review

continued

emerge. It is their contention that the enormous number of chemicals man has introduced into his environment (defined in the broadest biological sense to include drugs, food and drink as well as the biosphere) have precipitated a major evolutionary breakdown: human physiology simply cannot handle the vast range of chemicals to which it is now exposed.

A priori, there is no obvious reason to invoke allergy as the mediator of this breakdown. But clinical experience has led an increasingly large and confident group of physicians to attribute a phenomenally wide range of diseases (from ulcerative colitis to migraine, from arthritis to schizophrenia) to allergic responses to chemicals in the environment.

Mackarness's recitation of cases histories in many ways the most convincing argument in his book. Again and again he shows how clinical ecologists have alleviated symptoms by discovering which chemicals or food provoke allergic reactions in their

patients and persuading them to avoid exposure to those chemicals.

The list of chemicals that Mackarness believes can cause allergies is almost as long as the list of symptoms they provoke—hydrocarbons in hair sprays, polyester clothing, pesticides, anaesthetic gases, food dyes and so on. So avoiding exposures to all or several of these chemicals, can be extremely tiresome. Some patients even remove gas cookers and heaters from their homes (because the burnt and unburnt fumes in them are, Mackarness claims, "one of the commonest unsuspected causes of chronic illness"), eschew all plastic materials and rotate the foods in their diet (because eating one food continually can induce an "addiction").

Despite the detail of the case histories Mackarness quotes, I am not convinced that diseases such as ulcerative colitis are unambiguously rooted in the biochemistry of allergies. Mackarness's explanation that "food and chemical allergy disturbs en-

zyme systems" (which are essential to well-being), and that therefore allergies can disrupt all sorts of biochemical processes and lead to all sorts of disease, is trite and unfalsifiable. Exactly how, I kept asking myself, does exposure to a plastic carpet induce colitis?

But, of course, Mackarness is an enemy of reductionism. He berates the reductionists among allergists because they insist "that there must be a demonstrable immunological mechanism underlying the altered response (the allergy)". On the other hand, "it is enough to identify the offending substance to which the victim is reacting and to show that by avoiding it, symptoms can be averted or reduced".

Well, that may be enough for the practising physician with patients to cure. But it is certainly not enough for the scientists (which is why, I suppose, medicine is not science). Mackarness is wrong to imply that any quest for explanation—for mechanism—is reductionist. It is not. It is the very essence of science. And, as the sections of Mackarness's book that deal with the history of immunology amply demonstrate, it is science that throws medicine forward: without science, physicians would still be relying on the dubious embrace of the leech to cure their patients. **Lawrence McGinty**

The deadly element

by Lennard Bickel

Macmillan, pp 312, £7-95

This book describes the story of uranium, from its discovery in 1789 through to its role in the development of the atom bomb and atomic power.

The discovery of atomic and nuclear structure and the development of nuclear fission is a story full of drama and excitement. This emerges clearly in this book and the latter half, dealing with the period immediately before and during the Second World War, is compulsive reading. I am less enthusiastic about the early part of the book. This period does not contain the raw drama of the latter years and the author appears to have tried to compensate for it by injecting excitement. It is an excellent intention and may be enjoyed by many readers but I find the style irritating:

much of the material is in the present tense presumably to heighten the drama but at times this makes the material read as if it were in a popular tabloid. Pierre Curie didn't die but "his head was crushed into a Paris gutter"; and Moseley had "a bullet put through his brain".

Thankfully the later material is well presented. Lennard Bickel maintains a brisk pace and it is like reading an adventure story: the near misses of discovery, how Enrico Fermi early in the 1930s failed to recognise fission, blinded as he was by his search for transuranic elements. As Bickel wryly notes "it was an error... that almost certainly saved the world from... Nazi Germany armed with atomic bombs".

There are a few quasifacts in the book (is it really "Julius" Robert Oppenheimer?) but for the most part it is a welcome addition to the literature on this period. The memories of Leo Szilard have played a part in this and helped to give a perspective that was new to me. If you want to read an exciting factual adventure story, *The Deadly Element* is worth a try. **Frank Close**

Growth points in nuclear physics, by P. E. Hodgson (Pergamon, vol 1, pp 219, vol 2, pp 208, each £8). These books are a compilation of Peter Hodgson's own articles on the progress of nuclear physics, published over the past decade in *News & Views* in *Nature*, and in *Monitor* in the *New Scientist*.

As Hodgson writes in his preface, these are not textbooks, where tried and tested ideas are (or should be) expounded with a maximum of clarity. Instead they represent instant analysis of the subject as it developed, and contain reports on exciting new ideas whose promise evaporated as well as first thoughts on advances whose value has grown so that textbooks are now, or soon will be, available.

The reports are grouped by topic, and cover nuclear forces, reactions, shape, structure and size, but from a historical point of view, the most interesting is the group on the "superheavy elements". The story starts with a lecture given at Oxford on June 17, 1976, where the announcement was made that elements 116, 124 and 126 had been discovered. Transatlantic permission for the disclosure had

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been given, and, by bush telegraph, the lecture theatre was packed. Hodgson was there, and the story came as close to a "Stop Press" headline scoop as science journalism ever aspires. But then followed checks that failed to confirm the finding, and finally the authors retracted. Once more a 99 per cent certain discovery bit the dust. **Martin Goldman**

The papers of

Joseph Henry, Volume 3

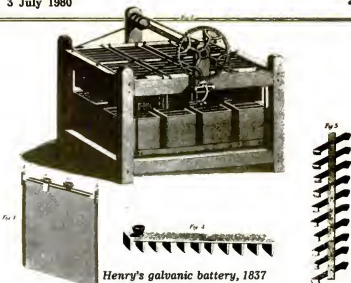
edited by Nathan Reingold

Smithsonian Institution Press,
pp 585, \$30

The latest volume of the papers of Joseph Henry deals with the period January 1836 to December 1837. It covers Henry's first visit to Europe, France and Belgium, and its raw materials are his diary and correspondence. His work on electromagnetism had made him the most eminent scientist to visit Europe since Benjamin Franklin, and this gave him the entrée to men of science wherever he went.

We are thus afforded a brilliant sidelight on physical science in Europe at this time, and one which is made all the more illuminating by the historical, social and biographical footnotes provided by the editors. These notes, which often contain more information than the text to which they refer, are the most outstanding example of conscientious scholarship that I have ever encountered as a reviewer.

On almost every page there is a fascinating item in the notes alone. For example: "Tycho Brahe lost part of his nose in a duel in 1566. When his tomb was opened in 1901, a green stain at the nasal opening indicated that his false nose had been largely of copper". Henry dines at the Athenaeum Club with "the little tables spread in different parts of the room with many occupied by single persons", or visits the Royal Institution to see Faraday, or Greenwich with Charles Wheatstone, or is a guest at the Royal Society Dining Club where he met Samuel Christie, the true inventor of Wheatstone's



Henry's galvanic battery, 1837

bridge. From Jacques Babinet he learns the details of Fresnel's bi-prism, while Macedonio Melloni shows him his instruments and discoveries in infrared, Charles Babbage his calculating machine, and David Brewster his discoveries in polarisation.

The only unhappy experience was the British Association Meeting in Liverpool where the Rev Dr Dionysius Lardner had concluded that steam boats could never sustain a speed of 15 miles an hour, and therefore refused to believe Henry's

statement that he had travelled the 150 miles from Albany to New York in nine hours.

In a review of a previous volume of this series I concluded that the prospect of its running to 15 volumes would make the series "unsuitable for purchase by any but major libraries". But, for anyone interested in the history of science the present volume is disqualified only by its weight from being marvellous bedtime reading.

R. V. Jones FRS

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Mr Hill is studying for an Honours degree in mathematics. Outside academic life, he helps with a Scout group and enjoys bridge, hiking, climbing and snooker.

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Review

continued

Serengeti—dynamics of an ecosystem

edited by A. R. E. Sinclair

and M. Norton-Griffiths

Chicago UP, pp 389, £17-50

The Serengeti Plains, in northern Tanzania, have experienced some profound ecological changes over the past 90 years beginning with the introduction of rinderpest (a viral disease affecting ruminants) in the 1890s. Periodic outbreaks of the disease and its final disappearance in 1963 have had far-reaching effects on the dynamics of the large mammal populations. The other important ecological change was the dry season increase of green forage in the north of the park following a climatic shift in 1971 toward wetter dry seasons. The result has been a near explosive increase in wildebeest numbers, which had reached 1.3 million in 1978. The repercussions of this massive alteration in the composition of the herbivore component of the ecosystem form the subject of this in-

teresting and informative book. It attempts an overview of all the research that has been carried out in the Serengeti—chiefly by the Serengeti Research Institute, which was established in 1966.

The first chapter recounts the history of the Serengeti National Park and discusses the dynamics of the flora and fauna, with implications for management, while the second briefly describes the Serengeti ecosystem, which appears to have changed little over the past million years. The next six chapters deal with the ungulates of the grasslands, mainly in terms of their feeding ecology. Chapter 8 on social organisation contains much previously unpublished material. There follow two chapters on predators and another on scavengers. The last two chapters examine various models of the ungulate populations in an attempt to forecast future trends. The book ends with three appendices of which one reports the results of the last (1976) aerial count made of the resident ungulates.

The editors give three main reasons for publishing the book. The first is to bring together the results of previous work into a coherent whole. In this they are generally successful although there are gaps: the woodlands are hardly mentioned despite some important studies within them, particularly of giraffe.

The second reason for publication is to provide information for the effective management of the park. Here the book is less successful if only because most wardens and park administrators will find much of it incomprehensible. Little specific guidance is given on management, other than to wait and see, and the general conclusion that non-interference is the best policy is one that the wardens would probably have reached anyway. For most purposes, the Serengeti is big enough to look after itself. I think the Serengeti biologists are unwise to labour the management value of their research, because in doing so they raise unrealistic expectations in the wardens.

The primary function of the scientists has been to make an in-depth study of the ecosystem and in this they have been eminently successful. The level and extent of the



Chris Jones

research has been greatly in excess of that needed for simple management but management needs have nevertheless been filled by the results of the research programme. The management implications of their work are pointed out by several authors although sometimes the conclusions seem too facile and are probably not generally applicable, particularly in small reserves.

One factor that is consistently left out of account is tourism, but no management plan is complete that ignores this very important industry. The "elephant problem" with the Seronera trees had little to do with ecology but was essentially a tourist-based matter. Nor can one exclude human pressures, which have been shown to be particularly severe around the Serengeti

National Park. The projections made over the next 80 years would be of little account in the event of social or political upheavals in the region.

The third justification for the book is that it vindicates the large amounts of money that have been spent on research in the Serengeti. Most readers will be convinced that the money has been well spent but a more serious worry is where the money is to come from in the future. As the editors point out, the ecological monitoring work has ceased through lack of funds and there is now no coordinated research programme. If this book can stimulate grant-giving bodies to dip into their pockets again, it will have provided a fourth, and perhaps the most important, reason for its publication.

S. K. Eitringham

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Hormones and evolution, edited by E. J. W. Barrington (Academic, pp989, 2 vols, £30 each).

"It is not hormones which have evolved but the uses to which they are put." This work amply demonstrates that the oft-quoted dictum is only partly true, and it is about the evolution of hormones as well as their changing uses. It is also more, virtually a prospectus of the present state of comparative endocrinology. The theme of hormones and evolution is a long-standing interest of Professor Barrington, who has assembled a team of 29 experts to apply this theme to their own fields and has himself contributed a characteristically thoughtful and wide-ranging introduction. In Volume I we find a chapter on steroids and evolution, including a stimulating grand sweep of speculation; then five chapters on invertebrate groups (annelids, molluscs, crustacea, insects, echinoderms), a chapter on catecholamines, and finally two chapters on the thyroid in cyc-

stomes and amphibians. My only quibble is that these two thyroid chapters belong in Volume 2 on vertebrates.

This second volume covers responses to neurohypophyseal principles; biochemistry of growth hormone, prolactin and gonadotropins; actions of prolactin; the ACTH/MSH family; hypothalamic releasing factors; gut hormones; avian reproductive periodicity; hormones in monotremes and marsupials; and the evolution of viviparity. The material throughout is comprehensive and presented with authoritative insight while retaining the virtues of interest and readability. Some chapters dealing with my own special interests strike me as brilliantly done and exceedingly stimulating. This work is a must for endocrinologists; further, since hormones penetrate so many aspects of animal physiology, perusal of these volumes would profit all biologists interested in how animals work and how their workings have evolved.

John N. Ball

Bookwatch briefs

Amateur astronomer's handbook, by J. B. Sidgwick, 4th edition, revised by James Muirden (Pelham Books, pp 568, £12.50). Ever since this book was first published in 1955, it has been the amateur's reference classic on all matters relating to astronomical instrumentation and practice, apart from actual observing techniques. Optically, the book covers practically everything the serious amateur is likely to need from image characteristics through design of systems and their aberrations to the latest catadioptrics. Mechanically, anything relating to telescopes, their mountings, drives, and all kinds of associated equipment, are dealt with—along with discussions on photography, vision and time reckoning. With such a comprehensive coverage, extensive revision was due after a quarter of a century. James Muirden, well-known writer in astronomy, has very commendably accomplished this mammoth task and has brought every aspect into line with current practice. There are a few errors, and though the price reflects its value to the practising amateur, I am not just recommending this book—it's an indispensable reference which completely outdates all earlier editions. **G.S.P.**



Gasohol for energy production, by Nicholas P. Cheremisinoff. (Ann Arbor Science, pp 140, £8.25). Gasohol may well prove to be a major form of bio-energy of the future. Certainly the prospects must be considered good in the humid tropics, where the most abundant natural resources are year-round warmth and moisture, enabling vast quantities of plant matter to be grown in short order. Brazil is generating ever-growing amounts of alcohol fuel from sugarcane and cassava. Ghana and the Philippines are experimenting with fast-growing tree farms for pyrolysed methanol. Several other developing countries are probing the prospect of utilis-

ing agriculture and forestry residues as sources of bio-energy.

This book, written by a chemical engineer with the Exxon Research and Engineering Company in New Jersey, is intended to be an "overview of the present state of the art". Technically the book is a useful survey of production methodologies, with some analysis of economics involved. Regrettably, though perhaps not surprisingly, it focuses almost entirely on opportunities and problems in the United States, even though it is in developing countries of the tropics that the need and potential are greatest—and where land and labour costs are lower than in the US.

The book winds up with 20 pages of references—a helpful source of information, which curiously pays little attention to writings by leading gurus in this field, such as Melvin Calvin etc. **N.M.**

The Department of Education and Science, by Sir William Pile (George Allen and Unwin, pp 247, £10), contains a brief and rather dry review of the history of government funding for science. It's interesting to be reminded that science had its own minister, independent of the education ministry, until 1964. Following the Trend report, the two ministries combined to form the Department of State we are familiar with today. The curious reader might spend a few minutes wondering why, 12 years on from the Dainton and Swann reports that identified the "swing from science" and the need for more highly qualified manpower to enter industry, we are still saddled with a chronic shortage of well-qualified engineers and scientists. These reports and other relevant documents, such as the Rothschild report on funding government R&D, have their conclusions briefly but handily summarised. **R.S.H.**

Microprocessor applications: International survey of practice and experience (Infotech International, pp 358, £49.50) is a set of papers that deal with almost every subject under the Sun. The link is that in each case the application has been helped in some way by a microprocessor. So if anyone ever asks you what are the links between nuclear reactors, ovens, drip-feed monitoring, weather forecasting and the examination of frogs, the answer lies in some of the case studies presented in this book. The volume will appeal mainly to people with technical minds because all the case studies contain con-

siderable technological detail. However, the breadth of application (Oxford UP, pp 271, £14.50), the microprocessors help, makes a fascinating read even for the layperson. **P.M.**

An introduction to human biochemistry, by C. A. Pasternak (Oxford UP, pp 271, £14.50), attempts to present in one short volume a molecular approach to biochemistry for the medical student. The idea is excellent but the book does not do it justice.

The first part deals with the basic structure and function of cells and their components and the second with cellular specialisation. Throughout deficiencies and malfunction which lead to disease are described and the underlying cause of the lesion explained. But it is when the real molecular detail is explored that the book really disappoints. The entire text is littered with errors, some of detail, some of concept, some obviously in the original script, others, I hope, arising during preparation for publication. Even these should have been picked up in the proof reading. However they arose, their presence makes it impossible to recommend this book as a single book on the subject as a whole. They will need a comprehensive and accurate biochemistry text as well which to a large extent negates the purpose of the book. For those already well versed in biochemistry, it does provide a novel approach. **C.J.B.**

Developments in deep-sea biology, by N. B. Marshall (Blandford, pp 566, £15), is a successor to the same author's *Aspects of Deep Sea Biology*, published in 1954, and integrates the many recent discoveries with earlier knowledge so as to provide a contemporary study of organisms which dwell in these least accessible areas of the world. Early chapters survey the environments, plants and animals of the oceans, while the second main section of the book deals with the complexities of food webs. A further four chapters cover the physiological problems connected with buoyancy, lunar, sensory systems and pre-adult stages and the final one relates ecology to the relevant biogeography.

Newly designed deep sea technical apparatus has been intentionally omitted, but I have no doubt that this recent, modestly priced, excellent Professor Marshall's work will prove interesting to a variety of marine biologists. It is certainly a worthwhile investment for any marine honours student worth his salt! **P.J.B.**

GAMES OF LOGIC

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Another delightful book from Pierre Berloquin, author of *Geometric Games*. Games of Logic is a stimulating collection of mind benders. The puzzles have been carefully selected or designed (many are original from the author or artist) so that none will be too difficult for the general reader to solve. Yet none are too easy. They are crisp, clearly given, with answers at the back of the book, and great fun to work on whether you solve them or not.



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Jack D. Dunitz

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Review

continued

Heritage Portraits of photography

The recently opened Kodak Museum at Harrow provides a focus on 180 years of photography, and is a fitting way for the company in Britain to celebrate the 100th anniversary of the founding, by George Eastman, of the parent company, Eastman Kodak, in the US.

To study the development of photography is to study not only the evolution of something that is part chemistry and part physics, but also social history and occasionally art. Each snapshot is a piece of history and each frame an integral part of an evolving scene. Equally relevant are the ways in which they were taken and the purposes to which they were put.

The new custom-built Kodak Museum complex is housed in the original factory building at Headstone Drive, Harrow. Built in 1891, it can claim to be the oldest surviving Kodak structure still intact and in continuous use. The collection is probably the largest in Britain and must range among the most important in the world. Here are glimpses of the founding fathers of photography, their science and inventions, and a taste of the multiplicity of uses found for their precocious brainchild.

Half of the new museum is concerned with the history of photography and the development of the camera. The remainder deals with the origins and evolution of the motion picture camera and with "photography in the Victorian drawing room".

No space is wasted, and displayed on the case-ends abutting the main aisle is a wide range of photographs illustrating techniques and processes used to fix an image. Included are early salted paper prints, albumen papers, emulsion papers containing silver

nitrate, and contact papers. The complex of pigment processes range from Bromol, Oleobrom, Ozotype and Gum Bichromates. Equally exotic are the iron-salt processes such as Platinotypes, Palladiotypes, Cyanotypes, Chrysotypes, and Kallitypes. The exhibits outline not only who invented them but also how they work.

The main displays take the visitor through Johann Heinrich Schulze's work (1725) on the effect of light on chalk moistened with silver nitrate, and Carl Scheele's explanations of why some silver compounds become blackened. Pride of place, though, for the first person to make an image on paper and leather goes to Thomas Wedgwood, son of the great potter. Around 1800 he experimented with white leather soaked in silver nitrate. That anything is known of his work is largely thanks to Sir Humphry Davy. It's interesting to speculate that had Wedgwood not died so young Davy might have been able to advise him on how to fix his fleeting images (even ammonia would have done the trick). The subsequent and seminal work by Jos Niece and Louis Daguerre leading to fixed photographs is well displayed. So also are many facets of the developments and refinements introduced by William Fox Talbot, who invented Calotypes, John Herschel discoverer of sodium thiosulphite, Hippolyte Bayard who produced direct positives on paper, and many other famous names.

A huge range of cameras is on show—perhaps too many for all but the professionals. But here are the famous Kodaks, the Bullets, Ensignettes, Brownies, Stereo Hawk-eyes, and many more recent cameras. Is it possible that the 1/8th size model of a 2C Brownie camera made in 1925 for Queen Mary's dolls' house was the forerunner of the



The new Kodak museum makes public a collection started by John Pledge in 1927. Below A reconstructed Victorian photographic studio. Bottom 1929 Kodak Vanity camera



sub-miniature cameras beloved of the espionage world—the Kodak MB (matchbox) of 1944 and the Steineck ABC wrist-watch cameras (1949)? Inevitably the camera section is rounded off with Edwin Land's considerable contribution to the "instant" camera.

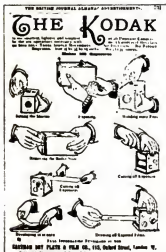
Flash bulbs pop up, as do photoelectric exposure meters, equalising lenses and a wide range of general accessories. Particularly interesting is the technique pioneered by John Dancer of Manchester, from 1853, of producing photographs of microscopic size. He produced for sale a large series of microscope slides bearing reduced photographs, smaller than a pin's head but full of detail when magnified. By the 1860s the technique was being applied to the commercial production of jewellery and trinkets with a built-in magnifying lens by which a tiny photograph could be seen when held to the eye. The exhibition includes numerous stereoscopes, ornate albums and miniatures.

A host of scientists some-



how get in on the show, including, via magnesium flash pictures, Michael Faraday (1864), Henry Roscoe (1864), and through the cartes de visite photograph first introduced in 1860), Charles Darwin, the Brunels, John Herschel, and David Brewster.

The museum contains such a wealth of treasures that anyone interested in photography is likely to want to make several visits. Fortunately it is open Mondays to Fridays from 9.30 until 4.30, and Saturdays, Sundays and Bank Holidays from 2 pm until 6 pm. Admission is free. **Richard Fifield**



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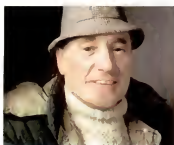


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no sign of it.

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is nothing to tell you that the top

of a pipeline runs one metre beneath your feet.

The sheer invisibility of the line
surprises visitors but not me. I was responsible for
re-instating the land and well know what
unprecedented lengths we went to. Every foot of
the way was photographed before digging started,
and the vegetation restored the way the record
showed it... even to the exact varieties of grass.

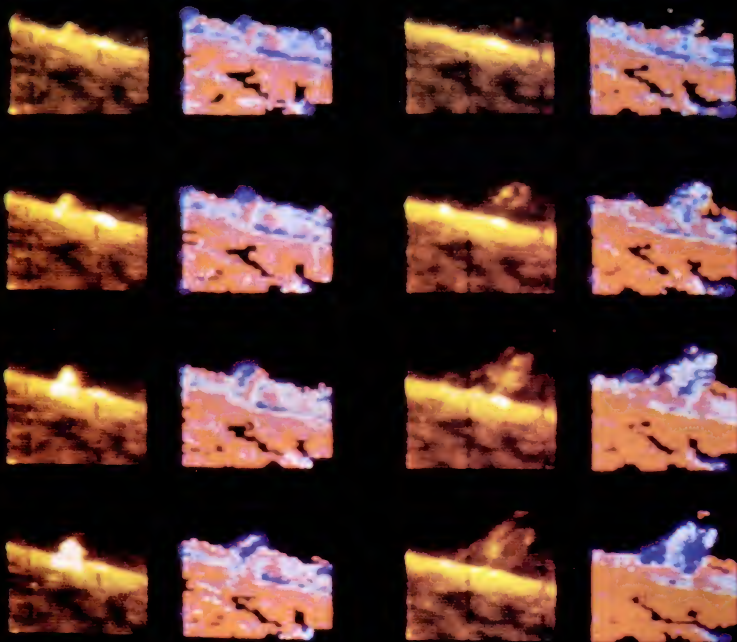
Sometimes, I agreed deviations in the
line to avoid disturbing rare trees. In addition,
a team of archaeologists preceded pipeline
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EXP # 2218

APRIL 30, 1980 FLARE

Hot gas billows from the south-west limb of the Sun on these computer images. The pictures are from the ultraviolet instrument on the Solar Maximum Mission satellite. In the two columns on the left, the pictures, taken 2½ minutes apart reading down the page, show the build-up to a flare. The two columns on the right, each row separated by 7½ minutes, were taken about an hour after the flare. The left-hand picture of each pair shows the intensity of ultraviolet radiation (emitted at 154.8 nm, the wavelength associated with triply-ionised carbon). The right-hand of each pair shows the velocity of material moving along the line of sight—red represents movement away from the instrument, blue towards.

The sequence on the left, taken just before the flare, shows a jet of hot gas rising from the "footprint" and filling the top of a loop. Some gas may even go to the other side of the loop—the velocity picture shows material moving towards the instrument. Three minutes after the last frame, an X-ray instrument on the satellite detected a bright flare. In the later sequence, on the right, material seems at first glance to be rising, but closer observation shows that new features are appearing successively higher up. This effect may be caused by gas that had been observed emitting "hard" X-rays during the flare, which begins to emit ultraviolet radiation as it cools.

Each picture shows an area 2 arc minutes square, with a resolution of 3 arc seconds. On this scale the Earth would occupy one-seventh of each frame.

The Solar Maximum Mission

Solar flares—highly energetic eruptions in the Sun's outer layers—come under the scrutiny of NASA's latest scientific satellite during the present peak in the cycle of the Sun's activity

Dr Christine Sutton "It's difficult to relate that thing up there to what we're doing," Chris Rapley remarked about the Sun, which was beating down on grass still green from the previous

week's heavy rain. But for Rapley and other scientists at NASA's Goddard Space Flight Center at Greenbelt on the outskirts of Washington, the Sun had been shining for 60 out of every 96 minutes during the past three months. It is from Goddard that the teams supporting NASA's Solar Maximum Mission monitor and control their instruments on board a satellite making an intensive study of the Sun, and solar flares in particular.

Although it is the nearest star to Earth, and therefore the only one that scientists can study in detail, the Sun remains enigmatic, presenting as many questions as answers (*New Scientist*, 24 April, p 201). What is known, but not yet fully understood, is that the Sun is far from being the perfect, unchanging celestial body that ancient philosophers believed it to be. One of the Sun's more remarkable features is its cyclic behaviour, in which solar activity, visible through relatively small changes in the Sun's appearance, waxes and wanes over a period of approximately 11 years. Towards the peak of such a cycle the number of sunspots—cooler regions of the photosphere, the Sun's apparent surface, that appear darker—increases to a maximum. At the same time solar flares become more frequent. These are violent eruptions of material in the Sun's outer layers—the chromosphere and corona (Figure 1)—which last from a few minutes to at most a few hours.

The density of material in a flare is low—less than 2×10^{-12} g/cm³—but the total mass and speed attest to the large amounts of energy involved. This energy, which can be as much as 1/1000 the normal total output of the Sun, is released in electromagnetic radiation—from radio waves to gamma-rays—as well as in bursts of extremely energetic electrons and protons. These particles form a "gust" in the solar wind, the steady flow of particles from the outer corona which streams out through interplanetary space. The Earth feels the effects of a flare a few days later when the gust disturbs the magnetic environment, disrupting radio communications and creating splendid auroral displays as the particles interact with the Earth's magnetic field. Through a coordinated programme of a large number of detailed measurements scientists taking part in the Solar Maximum Mission hope to learn more about the evolution and structure of flares—how they form, what conditions precede them, and what happens as the flaring region returns to normal.

The Solar Maximum Mission satellite (see Box) was launched on 14 February to take advantage of the current maximum in the solar cycle. The first solar observatory went into orbit about Earth nearly 20 years ago, but the Solar Maximum Mission is the first to be almost entirely devoted to the study of flares. It incorporates six instruments that can simultaneously view flares over a large slice of the electromagnetic spectrum—from wavelengths of 700 nanometres (1 nm = 0.000000001 m) in the visible band to those less than 0.001 nm in the gamma-ray range (Figure 2). Each region in the spectrum, as seen by these six instruments, paints a different part of the picture of

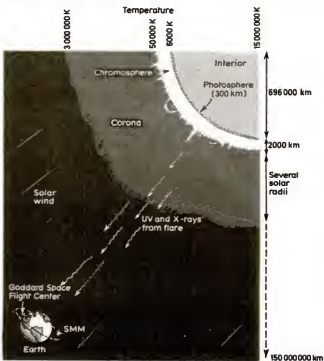


Figure 1 Solar flares originate in the Sun's invisible outer layers—the chromosphere and corona—and thrust out particles and radiation including ultraviolet (UV) and X-rays. High-energy particles from the corona stream far into space, forming the solar wind, while sunspots occur in the cooler photosphere, the Sun's visible "surface" Colour photo (left) courtesy of NASA

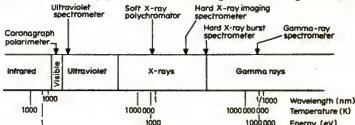


Figure 2 The portion of the electromagnetic spectrum covered by instruments on the Solar Maximum Mission, showing the relationship between wavelength, temperature and energy

the development of a solar flare. A seventh instrument, the active cavity radiometer, is to determine the solar constant, a measure of the Sun's energy reaching the Earth, to an accuracy better than 0.1 per cent.

All seven instruments on board the satellite represent, or extend, the "state of the art" in their fields—however, it's the incorporation of the various instruments on the same spacecraft that marks the most significant advance. By pointing at the same flare at the same time they can provide data that are correlated to an extent never possible before. Throughout International Solar Maximum Year, which extends to February 1981, the satellite's observing programme will also be coordinated with those of ground-based observatories, including radio-telescopes, as well as a series of sounding rockets.

Since the spacecraft's launch, the teams responsible for its instruments have been participating in a unique experiment in human relations. Scientists who use satellites generally have to be patient, waiting weeks or months for their data to be processed after collection. Each researcher

then takes the data that interest him alone and picks them bare of information. This makes collaboration with other researchers difficult and slows the spread of new results.

By contrast, the Solar Maximum Mission's scientists will work together at Goddard for the duration of the mission, which many now hope will be more than the year originally planned. All six teams with instruments studying flares have offices at the "Experimenters' Operations Facility" in Building 7 at Goddard. Five of the teams have set up major centres for analysis with minicomputers, tape units, disc drives, printers and visual display units, including colour graphics terminals—the researchers almost vie with each other to see who can produce the best "flare movie". In an atmosphere of friendly competition, members of the different teams can compare flare events just by crossing a corridor, and can cajole, tease, advise and learn from each other.

The satellite itself orbits Earth at a height of 574 km once every 96 minutes, and is above ground-stations for only a fraction of this time. So most of the data are not received "live", but are stored temporarily on a tape recorder on the satellite. The researchers do not sit watching their monitors, waiting for flares. Instead, like the White Queen in *Through the Looking Glass*, they discuss the Sun yesterday, tomorrow, but never today. Everyday at 1 pm representatives from each team gather to plan the observing programme for the 24-hours beginning the following morning. What has happened on the Sun during the past 24 hours and more is crucial, because the teams want their instruments to point at the place that is most likely to flare. While some instruments look at the whole Sun, others point together at the same small region, defined by the satellite's direction. To help select the best place for flares the scientists each day receive a "solar forecast" from the National Oceanic and Atmospheric

Administration's (NOAA) Solar Forecast Center at Boulder, which also has representatives at Goddard.

Another critical part of the planning cycle is the selection of a "joint observing sequence". One of the instruments—the hard X-ray imaging spectrometer—alerts the others at the onset of a flare, and so triggers a particular pre-programmed sequence of operations in which the measurements concentrate on a certain aspect of solar behaviour. For example, the soft X-ray polychromator may look at specific emission lines in the flare's spectrum to reveal information about the temperature of the plasma—ionised gas—in the flaring region. The Solar Maximum Mission carries the most complex instruments ever mounted on a satellite—four of them are controlled by microprocessors on board the spacecraft—and this allows the great flexibility the teams have in deciding which experiments to perform.

The scientists at Goddard have access to a large portion of their data only a few hours after collection, and they can take quick looks in "real time" as the satellite passes over one of the 10 ground-stations. Each team's first priority is to check that its instrument is behaving correctly and to look for examples of flares—on a good day there may be as many as six or seven.

Only a few months into the mission the researchers already have more than 50 data sets on reasonably large flares; all this when no "joint spectra"—those taken simultaneously at different wavelengths—existed before.

The Sun has so far proved cooperative. It was relatively quiet for the first two weeks after the launch—a blessing in disguise, for it enabled the teams to check out their instruments and perform crucial calibrations that tie together the measurements in different parts of the spectrum. Then followed a week of strong solar activity, and then another quiet week, so the researchers could sit

The solar flare observatory

The Solar Maximum Mission is the first to fly with the new "multi-mission spacecraft"—a reusable module containing all the satellite's support systems. This multi-mission unit, which is structurally completely separate from the part carrying the solar "observatory", consists of three modules—for handling commands and data, for attitude control, and for powering the spacecraft. NASA has developed the MMS so that it can be refurbished while in orbit—by replacing a malfunctioning module, say—and retrieved by the space shuttle. In principle the same control modules could be used for subsequent missions carrying completely different experiments.

Between the multi-mission section and the module containing the observing instruments there are two solar arrays that supply up to 3 kW of power; providing the satellite is not in the Earth's shadow—then nickel-cadmium batteries take over. The observatory module carries seven instruments which between them contain some of the most sophisticated apparatus ever launched into space. Microprocessors onboard are programmed to control the sequence of measurements that four of the instruments make. Following instructions received from ground, these instruments can work together, collecting data relevant to a particular scientific problem, such as the temperature of plasma during a flare.

The satellite is carrying the following instruments:

- Active cavity radiometer: three detectors (pyroheliometers) measure the flux of solar radiation between far ultraviolet and far infrared wavelengths, with an uncertainty of better than 0.1 per cent.
- Coronagraph / polarimeter: photographs the corona from 1.7 to 6 solar radii using a vidicon camera which gives pictures with 896 x 896 elements. The instrument views wavelengths from 400 to 700 nm and has a choice of seven filters and three polarisers.
- X-ray polychromator: consists of the "flat-crystal spectrometer" and the "bent-crystal spectrometer" each of which contain a number of crystals to provide spectra of X-ray emission lines with wavelengths between 0.14 and 2.24 nm. The flat-crystal spectrometer can be scanned across a field of view of 7 x 7 arc minutes (the Sun's diameter is about

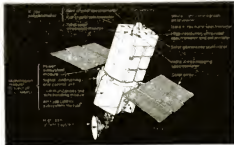
half a degree), with a spatial resolution of 10 arc seconds. The bent-crystal spectrometer produced X-ray spectra with, for the first time, very good time resolution of 0.1-10 s.

- Ultraviolet spectrometer and polarimeter: incorporates a reflecting telescope, which scans a field of view of 4 x 4 arc minutes with a minimum resolution of 3 arc seconds, and a spectrometer that can select spectral lines corresponding to temperatures at different heights in the chromosphere and the corona. This instrument provides the first ever polarisation measurements at these wavelengths.

- Hard X-ray imaging spectrometer: has a total of 512 imaging elements—coarse elements with 32 arc seconds' resolution and fine ones with 8 arc seconds' resolution—to give simultaneous imaging of a field 6.5 arc minutes square. This is the first time that hard X-ray images have been obtained. The instrument is sensitive to X-rays with energies between 3.5 and 30 keV.

- Hard X-ray burst spectrometer: a caesium iodide scintillator detects X-rays up to 300 keV in energy, and can resolve variations with time as short as 10 ms.

- Gamma-ray spectrometer: sodium iodide and caesium iodide crystals detect gamma-rays with energies from 0.3-10 MeV and above, and give accurate shapes for the spectra of emissions at these energies. □



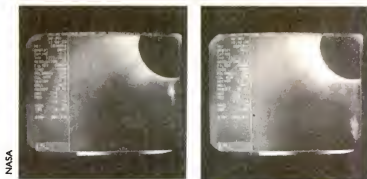


Figure 3 Images from the coronagraph/polarimeter, in which a disc creates an artificial eclipse with 1.7 times the Sun's radius. In the 1 h 40 min between the images a "transient"—plasma ejected during a flare—moves some 13 000 000 km out into space

back a little and look at what they'd just seen.

In its first months the Solar Maximum Mission has already produced new insights into solar activity, including an impressive list of "firsts". The coronagraph/polarimeter supported by a team from the High Altitude Observatory at Boulder incorporates a disc that blocks out the main body of the Sun, creating an artificial eclipse so that a TV camera can photograph the corona. According to Lewis House, principal investigator for this instrument, it has already revealed at least one example in which the kinetic energy of a "transient"—plasma ejected during a flare through the corona and into space—amounts to twice the energy radiated by the flare. His team can measure the rate at which the transient moves between successive frames (Figure 3) and can calculate its mass from the amount of light scattered by the electrons the plasma contains. Other pictures reveal the development of structures in the corona over a succession of orbits, and eventually the data should indicate how these phenomena are related to flares.

The deepest view

A team from the Marshall Space Flight Center and from Goddard itself is in charge of the ultraviolet spectrometer, which looks at relatively cool regions of the Sun. Its measurements of the absorption lines of singly-ionised magnesium, around 280 nm, give the deepest look into the Sun of any of the instruments, as this ion exists only at the temperature of several tens of thousands of degrees kelvin in the lower chromosphere. Using measurements of emission lines, the team can produce "dopplergrams" which give information about the velocity as well as the abundance of the emitting ions (Figure 4). The researchers use their minicomputer to put together "movies" that show the development of structures in the chromosphere, and the way material moves in loops and arches above the photosphere (see colour pictures). Through its unique ability to make polarisation measurements the ultraviolet instrument has produced the first ever information about the magnetic fields in the transition region—a layer some 10-100 km thick, between the chromosphere and the corona. These fields must be "substantial" to have been recorded at all, according to one member of the team. Other measurements indicate the existence of velocity oscillations with a period of about three minutes, along the instrument's line-of-sight. These oscillations also occur in the transition region, but only over sunspots in the photosphere below.

The satellite carries three X-ray instruments. One of these is the X-ray polychromator, built by teams from the Mullard Space Science Laboratory of University College, London, the SRC's Appletton Laboratory and Lockheed's Palo Alto Laboratory in the US. This instrument

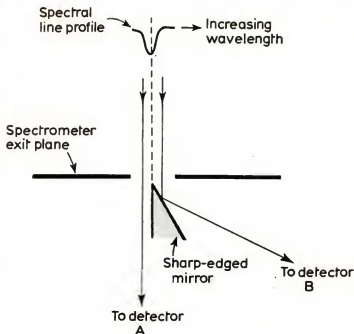


Figure 4 The ultraviolet spectrometer spreads the light it receives into different wavelengths, like a prism does, and as light leaves the instrument it is divided by a mirror. By adding light detected at A and B the scientists measure the total intensity; the difference gives a measure of the velocity of the source, as light from material moving towards (away from) the instrument is shifted by the doppler effect to shorter (longer) wavelengths

responds to X-rays corresponding to plasma temperatures in the region of 1.5 to 50 million degrees. It comprises two spectrometers, one to give good spatial resolution and one to provide good temporal resolution. These detect spectral lines from highly-ionised atoms of elements such as iron, calcium, neon and magnesium. Two-dimensional pictures from the flat-crystal spectrometer have shown material between sunspots emitting X-rays, possibly after being lifted into regions of higher temperature in the corona, in loops that link the spots (Figure 5). The bent-crystal spectrometer on the other hand is of a novel design that provides the first very high-resolution time spectra of flares. This instrument has revealed that in the early stages of a flare, the effects of turbulent motion broaden emission lines (Figure 6). Minutes later the material slows down and the lines become much narrower.

British scientists are also involved with another X-ray instrument—the hard X-ray imaging spectrometer—which has been put together by a team from the University of Birmingham collaborating with Dutch colleagues from the

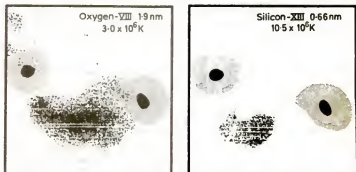


Figure 5 X-ray images from the flat-crystal spectrometer reveal high temperature material in loops above sunspots in the cooler photosphere. A "white-light sensor" determines the locations of the sunspots that are too cool to be seen at X-ray wavelengths

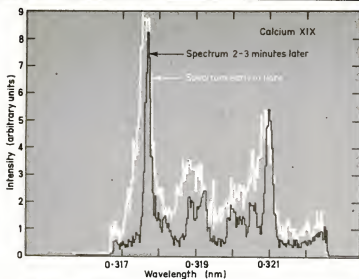


Figure 6 X-ray spectra of calcium atoms, with only two of the usual 20 electron remaining, become narrower during the course of a flare, suggesting the material becomes less turbulent

University of Utrecht. This instrument not only gives the "flare alert", but provides, for the first time, two-dimensional pictures in six high-energy X-ray wavelength bands. Detailed knowledge of the location of such "hard" X-ray emission is crucial to understanding the mechanism underlying the flare. The team can also construct "movies" showing the development of flares.

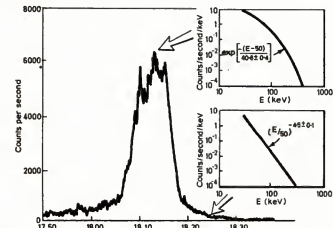


Figure 7 Energy spectra at separate times during a flare detected by the hard X-ray burst spectrometer have different shapes, suggesting that different processes are accelerating the material to high energies. The exponential curve (top) is typical of thermal processes

A third X-ray instrument, the hard X-ray burst spectrometer, detects very high energy X-rays and can measure variations over time intervals as small as 0.01 seconds. X-ray data contain information about the processes that have accelerated the radiating particles to high energies, and so give clues as to the mechanisms involved in the violent release of energy in flares (Figure 7). This instrument observes the whole Sun; indeed, the researchers at Goddard cannot always be sure that the X-rays it detects come from the Sun—in one example of a particularly energetic flare event, Brian Dennis believes they may have recorded not a solar flare but one of the mysterious gamma-ray bursts that are currently baffling astronomers. And in another example, the team looking at data from the X-ray polychromator is studying a possible correlation between a burst of low-energy (soft) X-rays seen by this instrument at the same time as an event in the hard X-ray burst spectrometer (Figure 8).

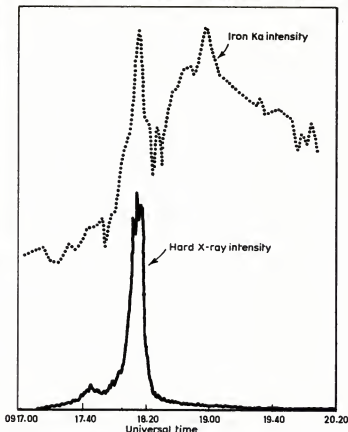


Figure 8 Low-energy X-rays from neutral iron (so-called K α radiation), detected by the soft X-ray polychromator, show a peak at the same time as high-energy X-rays registered by the hard X-ray burst instrument. It may be that energetic electrons exciting the hard X-rays in the corona also go down to the cooler photosphere to there ionise iron that is more or less neutral

Finally, the gamma-ray spectrometer registers the highest energy radiation of all the instruments. This was built by scientists from the Max Planck Institute at Garching, the University of New Hampshire and the Naval Research Laboratory in Washington. According to Ed Chupp, principal investigator, this instrument has recorded solar flare emissions up to energies as high as 8 MeV. When combined with other observations these new results will give a powerful insight into the Sun's ability to accelerate individual particles to extremely high energies. This instrument has also recorded the same gamma-ray burst that the hard X-ray burst spectrometer saw.

According to Chris Rapley, from University College, London, and a member of the group responsible for the X-ray polychromator, all the teams have far more data than they expected. "Technically," he says, "the mission is an absolute roaring success, with instruments working at 90 per cent of our wildest dreams of their capabilities." Not only the speed at which the scientists receive their data from the satellite, but also its quality, is far superior to previous missions.

The success—or failure—of the Solar Maximum Mission in elucidating the mechanisms that underlie sporadic events on the Sun will, in Rapley's eyes, have far-reaching implications. "Success," he says, "will emphasise the power of a joint effort on this unprecedented scale and will point the way for understanding far more esoteric and complex processes taking place in stars and galaxies at vastly greater distances from the observer. Failure, other than for technical reasons, could seriously undermine this philosophy." The Sun is the nearest star to Earth, and the only one that scientists can study in detail—understanding it is of paramount importance. □

Forum

A GROUNDLING'S NOTEBOOK

BUPA's shocking news

Donald Gould



Well, well, well! The British United Provident Association has discovered that artisans, or what our American cousins call, I believe, "blue collar workers" are a good deal more prone to "the diseases of affluence" than their bosses higher up the scale in the industrial hierarchy. This remarkable finding is an indirect (or, maybe, direct) result of a deal made between BUPA and the Electrical Trades Union last year, which shocked all good

socialists, and had all good Thatcherites chortling with delight. "You see!" exclaimed the Thatcherites, "they are a bunch of hypocrites and humbugs, these so-called workers. When it comes to the crunch, they're really no better than the rest of us."

And "Traitors!" shouted those unions who haven't yet got around to making a similar deal.

As this is a journal with an international influence and circulation, I suppose I'd better use a little space to explain what I'm on about, for I mustn't assume that all my readers (both of you, my dears) immediately recognise BUPA for what it is, or why any kind of arrangement between BUPA and any trade union is, on the face of it, grotesque.

So what is BUPA?

Well, let's start with the name. Any time you come across an organisation which accepts money from the public, and which includes in its title and description such words as "trust" or "permanent" or "mutual" or, even, "provident", you should start polishing up your spectacles.

I am not, of course, suggesting for a single moment that any of the firms which sport such epithets in their registered and published names are anything less than stuffed to the rafters with probity and good intent, but, on the whole, they tend to be rather dull, and to offer rather less by way of return for cash received than might be expected from the noble nature of their appellations.

Thus BUPA, which, while brandishing the term "provident" on its banner, is, in fact, no more than an insurance company which offers subscribers the chance to lie sick in a private room, and perhaps to "jump the queue" for specialist attention, when, rarely, the need to go to hospital happens.

It is a rubbishy offer.

When you really need the best that medicine can offer, BUPA can't do much about it. BUPA can't arrange for your leukaemic child to have a bone marrow transplant. We have, despite its present trials and tribulations, a magnificent National Health Service, which, through the agency of family doctors and the hospitals, makes a pretty good job of ensuring that most of us receive, at the time of need, adequate, and often excellent, health care.

BUPA, I suggest, doesn't have a proper role to play in the provision of medical services to this nation. It is an agency

which is encouraging and sustaining the commercialisation of a public service which ought to be divorced from commerce.

Which brings me back to my beginning.

In a survey of 540 electricians, "screened" by BUPA doctors and technicians, under the arrangement between the company and the union reached last year, it has been "discovered" that these "workers" are considerably less healthy than a group of managers who are older by a decade.

The "workers" drink more, smoke more, are fatter, and have a higher blood cholesterol level.

What a discovery!

It isn't the managers who are most at risk, and most in need of the services BUPA offers. It's the poor bloody infantry.

I don't suppose that this discovery could have anything to do, could it, with that contract with the Electrical Trades Union?

You wouldn't suppose, would you, that BUPA is turning its benevolence toward the health needs of the working classes because that's now where the money lies?

Nonsense, of course.

PERSPECTIVE

The evolution of the genetical theory of social behaviour

Jon Seger and Paul Harvey

The emergence of sociobiology was presaged in 1964 by W. D. Hamilton's two papers outlining the concept of inclusive fitness. The papers were important because they showed how natural selection could favour genes that induce altruistic behaviour. Sociobiology was officially born over a decade later, in 1975, when E. O. Wilson published *Sociobiology, The New Synthesis*. A major controversy over both the scientific basis and the political implications of the subject immediately followed the appearance of Wilson's book.

Hamilton's papers are entitled *The genetical evolution of social behaviour, I and II*. Some time ago we noticed that several authors were citing them incorrectly as *The genetical theory of social behaviour*. A survey of more than 200 citations from 1965 up to the end of 1979 revealed an error rate of about 20 per cent. And it wasn't just the critics of sociobiology who were getting it wrong (for example Stephen Jay Gould, Richard Lewontin and Marshall Sahllins), but also the sociobiologists themselves (David Barash, Richard Dawkins, John Maynard Smith and Wilson himself). We realised at once that the error is an easy one to make, because R. A. Fisher's classic work on population genetics is entitled *The Genetical Theory of Natural Selection*. But we also realised that this natural confusion cannot explain why incorrect citations become more common with each passing year. We decided to get to the roots of the matter.

Our first clue came with the observation that in our sample of 63 papers published before 1975, only one had substituted *theory for evolution*. Why should 1975 be such an important date? Wilson's *Sociobiology*, of course! Could it be that reading the work, as many sociobiologists and their critics must have done, helps one to misquote Hamilton? A long shot perhaps, but testable. According to our data, in papers written since 1975 39 per cent of authors who quoted both Wilson and Hamilton made the error, compared with just 20 per cent who quoted only Hamilton. The difference in frequency between the two samples is significant at better than the 1 per cent level of probability. We can hardly suggest that those misquoting Hamilton's paper haven't read it as one of us (PH) is among their number, and he can be proved to have read it before citing it. Wilson's extensive bibliography, which contains the error, provides a unique coverage of the sociobiological literature prior to 1975. We suspect that many authors have used it for convenience while compiling the reference lists appended to their own works.

However, the mutant reading (a meme as some sociobiologists might call it) appears to have had at least three independent origins. Richard Dawkins produced a handout for a course at



Oxford in 1970 in which the error can be found. Y. D. Lubin made the same change in a paper published by the Linnean Society in 1974. But neither of these mutations, unlike Wilson's, seems to have offered a successful challenge to the wild-type reading. Perhaps this note will lead scientists back onto the course charted so clearly by Hamilton in 1964. Or perhaps the scientific community will decide to have the papers officially renamed. And perhaps some people will read them for the first time. □

PANORAMA

Landscape = habitat + man

Jane Brown

If the coming of summer makes you long for more than a pocket handkerchief of sky then imagine, for a moment, your particular heaven, and hopefully the word "landscape" will come into view. I would not wish to spoil your reverie, but would ask, as you sit with the sun on your back, if you would consider that word, landscape.

To begin with a dictionary definition. After reminding us of the 18th century "landscape" such frivolity, indeed the *Shorter Oxford* (3rd ed) gives several definitions, all enmeshed in art or gardening and full of 18th century allusions; it was therefore with some relief that I found Chambers' *Twentieth Century* tome according the No 1 spot to landscape as "the appearance of that portion of land which the eye can view at once". No tanglings with Constable or Capability Brown here, thank goodness, and nothing to say if the view should be taken from the top of a tower block or the top of Ben Nevis.

All of which leads me nicely to an anniversary, for the late Nan Fairbrother's *New Lives New Landscapes* was first published 10 years' ago. It became a best seller and won the W. H. Smith & Son Literary Award, and it is in Nan's introduction to her book that you will find the equation of my title—Landscape = habitat + man. If habitat is nature's doing, that is our natural surroundings, then it is certain that in these islands there is nothing that has not been influenced by man, his agents or ideas, and thus our habitat has become our landscape. Contrary to much popular opinion therefore, and in common with wildlife (for foxes and hedgehogs are happy in town gardens and kestrels haunt city towers) the landscape comes right up to our front doors.

It follows that it cannot be somewhere just for Sundays and bank holidays, nor the lot of only a few gamekeepers, foresters and farmers who profess to be truly at one with their surroundings ("It's not just a job but a way of life"). Landscape, with its infinite variety of views, surrounds all of us and should be just as much subject to discussion as are the arts, politics, fashion and fast cars, and though newspapers and magazines, the television and radio, are full of those things you will have to look long and hard to find informed discussion of the merits, or otherwise, of a given view in the landscape—or at least any that is not sentimentally or exotically inclined. (Sentimentally = looking back at the old days and wishing Britain was still like that; exotically = looking at another land where the Sun shines more often and wishing Britain was like that.)

Sentiment plays too great a part in education about our surroundings. From our earliest schooldays the subject of what man has done to much of his habitat in the past 50 years is assiduously avoided. We do not seem to realise that, to a child, learning about the flowers of the hedgerow from a beautifully coloured poster has the quality of a pointless dream if the journey to school only displays paling fences, brick walls and a few measly dandelions that have survived the council herbicides. Pipe dreams at school, overlaid with the media's obsession for nostalgia and reinforced by a few visits to a stately home insure that many of us grow up with the conviction that Britain as a generous green and pleasant land is a figment of the imagination or at least reality to only a chosen few. It certainly does not look like that from where most of us live now. I believe that, as a consequence of this national thought process, most of us cease even to look at our surroundings and certainly do not look closely enough to get involved or to have any faith in



changing them. Most people only realise their surroundings are there at all when someone threatens to flog a motorway across the view or tunnel beneath it, and in that situation any discussion is purely negative.

Surely we must accept our habitat as we have made it—or at least make it into something we can accept. We must agree that pretty landscapes would be far prettier if they were not museum pieces for tourists but earning their living with integrity; that agricultural landscapes cannot be all patchworked and hedged but that there are many, many places where new large-scale farming would be more impressive; that industrial and urban landscapes are not uniformly drab and derelict but hold much beauty and many treasures—as W. C. Teagles' heartwarming nature study of the Black Country, *The Endless Village* has effectively shown.

We have to stop parcelling out places for specific purposes anyway—at least in the sense that they are pre-judged as good or bad without a second look—and learn to recognise our surroundings as a relevant whole. If we do not the warning has been given—a Dutch landscape designer, Hubert de Boer, has likened our viewing of our surroundings to watching an old and jerky movie clip with "short moments when one is subjected to a scenic view but never connected with the landscape as a whole". He warns that: "As long as there is no coincidence between the imaginary landscape that we want to 'see' and the real world landscape that is actually there, people will continue to experience fundamental conflicts in their attitudes towards the landscape, conflicts which will confuse the way they live with and relate to their environment, and, in turn, the rest of society." If this sounds like a problem that is already in our society then it must be the concern of those who care for the welfare of minds and resultant actions; my concern is more for the landscape that is being shattered thus. The thousands of professionals who now find themselves working in the environmental cause can only give us the technical advice and dummy runs—the creation of the reality of the equation—Landscape = habitat + man depends upon the involvement of the rest of us who just happen to live here. □

DESERT SONG

Ayatollah's dilemma

Ziauddin Sardar

Fahmy Saddy, of the rather battered American University of Beirut, is a man after my own heart. Passionately concerned about the preservation of Islamic cultural and traditional heritage, he is deeply worried about the impact of rapid industrialisation and massive transfer of technology on the Middle Eastern society. When I met him last he was thinking over what he called "the Khomeini dilemma".

When Ayatollah Khomeini returned from his exile in France to lead the revolution in Iran he took a Boeing 707. Throughout the popular uprising that preceded his triumphant return his messages were disseminated through tape cassettes. Without the Boeing 707, the cassettes and the instant communication link between Paris and Tehran, the Iranian revolution would not have been possible. "The Ayatollah would have remained an isolated voice in the wilderness."

The Ayatollah's dilemma is that a revolution in the name of Islam, for the establishment of an "Islamic State", against "Western materialism" and "degenerate progress" was made possible by the fruits of the Western mind. By Allah, it hurts!

All societies of the Middle East face the Ayatollah's dilemma. Fahmy reckons that it can be resolved by clarifying the conceptual problems involved in the transfer of values. There is no opposition in most of these societies to the transfer of tech-

Forum

continued

nologies themselves: except in extremely conservative pockets of reaction and fundamentalism, science and technology is highly appreciated. The opposition is to the values that are transferred and the threat they pose to the society's moral and ethical fabric. The technologies that are transferred to the Middle East carry with them a mixed bag of values, positive (from an Islamic point of view) as well as negative. "What the Middle East societies would like," says Fahmy, "is to separate the positive values from the negative ones and insist on admitting only the former while keeping out the latter." This has naturally proved to be a difficult task that has raised more cynicism and hostility between the Middle East and the West than any other issue in recent times. The rejection of the negative effects of technologies, asserts Fahmy, has often been equated with the rejection of the West itself. Modernisation has been perceived as Westernisation, and fighting modernisation—as in the case of Iran—has often driven people to fighting the West.

If it were possible to enhance the positive aspects of technology and restrict its negative aspects, suggests Fahmy, it would lead to the resolution of the controversy between the protagonists of modernisation and their opponents; and it will also lead to the evaporation of the hostility between the Middle East and the West.

The development of technology in the West was made possible by developing some ethical and moral dispositions towards concepts such as work, innovation, commitment, perseverance, maintenance, time and reward, says Fahmy. The West had time to grow with these concepts, to blend with them, to digest them, to internalise them and finally, to give their soul and spirit to them in the creation of a technological civilisation.

"The acquisition of technological innovations by Middle East societies requires their identification with some of the values associated with these innovations," says Fahmy. Societies that do not develop this sense of identification are merely consumers of technology, and not genuine participants in the shaping of their own destiny. "For example," says Fahmy, "if a society is serious about industrialisation, then along with the machinery and know-how it must also develop appreciation for Western concepts such as the importance of time, schedule and maintenance. If the same society wants to modernise its transportation system it is not enough to construct roads and instruct drivers to follow traffic regulations. In fact, more than regulations are required for an orderly traffic movement: a set of ethics, such as courtesy, that applies when the traffic regulations are silent. In the absence of this set of ethics the car could become, as it has in cities like Jeddah, Tehran and Tripoli, an instrument of death."

Even the most obviously positive technologies can sometimes have rather subtle negative impact on traditional culture. Fahmy gives the example of the telephone. "The telephone was developed in the West to respond to people's need to communicate with each other and it is simply unthinkable today that a modern society could function without it. However, the effect of the telephone on the family—particularly on the traditional ones—in the Middle East is rather culturally subversive. Families would rather phone than visit each other. It brought boys and girls together instantly under the nose of the parents, thus often not adequately appreciated and pursued, while the negation of the sexes for centuries."

While taking issue with the finer shades of Fahmy's argument, I, for one, would go along with him. The realisation that technologies come in packages containing both values and social and cultural instability factors is now gaining ground in the Middle East. Middle East societies that seek overnight modernisation would have to accept the package deal in toto. Also gaining ground is Fahmy's assertion that the apparent animosity that exists between the Middle East and the West is due to the inability of the former to make good use of the latter's innovations. The positive values of technologies are often not adequately appreciated and pursued, while the negative effects are understood to be the essence of "Western degeneration". But, as Fahmy points out, this is a twisted perception of what the West can offer in terms of both technologies and values and their relevance to Islamic societies. Essentially, this is the dilemma with which Ayatollah's Iran and other Middle Eastern societies will struggle in the decades ahead. □

WASHINGTON VIEW

National Academy

scandals

Dan Greenberg



Like its ancestor, the Royal Society, our National Academy of Sciences is a venerable institution that generally goes without public notice except when ceremonially praised as a pillar of national wisdom.

Lately, however, the Academy has been publicly pelted with abuse, some of it coming from such establishment quarters as the *New York Times*, the *Washington Post*, and several major medical and scientific organizations.

The origin of these assaults is in the essential difference between the Royal Society and the National Academy of Sciences. While the former is primarily an honorary organization, the latter, as it has evolved, is only incidentally an honorary body. Like the Royal, the Academy bestows its membership on what is supposed to be the creative elite of the national scientific enterprise; but, in addition to that, the Academy is a vast consulting business, with the US government as its principal customer.

What the Academy claims to offer is disinterested expertise on science, technology, engineering, health care and related matters. But it has now been revealed, and in unambiguous terms, that this self-styled supreme court of science has let itself be manipulated by a narrow, industry-oriented faction in the long-running controversy over the relationship between diet and cardiovascular disease. The reaction has extended from editorial criticism in the aforementioned newspapers to a congressional hearing at which various medical specialists attacked the thesis that healthy Americans shouldn't worry about super-saturated fats and cholesterol in their diets.

The source of this bit of nutritional iconoclasm was one of the 800 or so committees, panels, boards and other groups that perform studies for the Academy's clients—in this case, the 15-member Food and Nutrition Board. Most of its work, such as periodically calibrating the basic nutritional requirements of the general population, is paid for by government agencies in the US. But the big and booming food-processing industry is, of course, keenly interested in the public pronouncements of this influential body, and a group of firms regularly contributes funds to be used at the discretion of the board. Since that is the only uncommitted money at the board's disposal, it may be assumed that it financed the costs—no pay, just expenses, as is the Academy's way of using consultants—of preparing the controversial report, "Toward healthful diets".

Most of the commentary and advice in that slim product—all of 20 pages—is mainstream stuff. But on the subject of cardiovascular disease and diet, the board took the position that nothing has been absolutely proven, and, therefore, healthy folks ought not to modify their diets, regardless of recent government recommendations to the effect that fat reduction is a prudent move.

Now, some might dismiss all this as just another of those instances in which doctors disagree, but as the episode unfolded, it turned out to be far more than that. The report was drafted by a longtime consultant to the American Egg Board, Robert H. Olson, a biochemist at the University of St Louis; the chairman of the board, Alfred H. Harper, a biochemist at the University of Wisconsin, is another longtime industry consultant as are several others on the Academy group.

Further, it was revealed that the Academy did not employ its customary and rather elaborate reviewing process for the final draft of the report; rather, it sent the draft to three outside scientists, one of whom has long been associated with the

report's position on diet and heart disease. It was also found that when the report was in final form prior to publication, the president of the Academy, Philip Handler, expressed himself as "enthusiastic" about it.

Handler, who must retire from the academy next year at the completion of a second six-year term as president, has appointed himself to lead a counterattack on public interest scientists who support government regulation of industry. Recently revealed as having accepted appointment as a director of a major pharmaceutical corporation, Handler has decried what he refers to as "the nay-saying philosophy that has gripped us for a decade..." and he went on to say that "if the scientific community will not unrock the charlatans, the public will not discern the difference and the nation will suffer".

The Academy president's call for a holy war against those who disagree with him went largely unnoticed. The same cannot be said of the supposedly impartial study that a pro-industry faction foisted on the public. The *New York Times* described it as "so one-sided that it makes a dubious guide to national nutritional policy". And the *Washington Post*, said the report, "soiled the reputation both of the [Food and Nutrition] Board and of the Academy for rendering careful scientific advice". □

WESTMINSTER SCENE

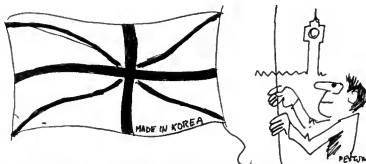
Made in parliament

Tam Dalyell MP

There is a great deal of parliamentary steam behind the campaign to do something about the need for marking the origin of goods in the shops. On 21 May, the government issued a consultation document on the extension of compulsory country-of-origin marking for certain groups of consumer goods; clothing, textiles, footwear, electrical appliances and cutlery. The Minister for Consumer Affairs, Sally Oppenheim, claims that two consumer surveys have shown that for those goods the country-of-origin marking is needed for genuine consumer reasons. In the light of the responses received from those likely to be affected, she intends to prepare draft orders under the Trade Descriptions Act, with a view to bringing them before the House in November or December. (So, if you have views on the subject, get those views to the government, and Mrs Oppenheim's office, before the end of July.)

Nicholas Winterton (Macclesfield), often outspoken in criticism of his own ministers and a long time campaigner for country-of-origin marking, voiced his approval. Winterton then observed that many British retailers, such as C & A, and British Home Stores, "do no service to this country by, as it were, apparently offering British-made goods, when the vast majority of those goods are manufactured abroad". Mrs Oppenheim responded that branded goods already had to show a country of origin. Alan McKay (Penistone) wanted the government to make sure that the words "Made in Sheffield" are stamped on cutlery which is wholly made in Sheffield, and not on that which is partly brought in from abroad. Mrs Oppenheim replied that this was one of the problems of origin marking which the government is discussing during the present consultations. Former trade minister, Anthony Grant (Harrow Central) said that origin marking provided useful information to the consumer, but that all the origin marking in the world was no substitute for good quality, at the right price, delivered at the right time, a sentiment with which Mrs Oppenheim agreed.

John Fraser (Lambeth, Norwood), Mrs Oppenheim's predecessor and Opposition spokesman on consumer affairs, wanted to know if the legislation would extend to advertisements in colour supplements, which are a very big source of consumer orders. Fraser thought that if the origin-marking provision did not apply to supplements and advertisements, it could well defeat the object of the whole exercise. Mrs Oppenheim gave Fraser the firm undertaking that the main manufacturing process would determine the country-of-origin. The government recognised that there are some difficulties with advertisements and small mail order catalogues because they are outside the Trade Descriptions Act. However, if the government became convinced that origin-marking in advertisements and mail order catalogues was necessary in the consumer interest, it would



have no doubt that these difficulties would be overcome. MPs will scrutinise with interest the orders to be laid before parliament in the autumn.

One of the most interesting visits I have made since becoming a member of parliament was to the new London Bridge area resignalling scheme headquarters at London Bridge Station, along with Gordon Bagier (Sunderland) and Leslie Spriggs (St Helens), both ex-railwaymen. Robert Belwyn, head of British Rail's Southern Region, and his technical director Cedric Knott, showed us their pride and joy, a computer-controlled signal box which has replaced 16 other signal boxes, reduced staff numbers and operating costs, added 11 per cent to punctuality (13 per cent at the rush hour), and made it infinitely more possible to deal with disaster or unusual circumstances in an area that stretches from Woolwich, through Eltham to Norwood, the busiest passenger concentration in Europe.

The facts are astonishing—1650 trains pass through the London Bridge area daily, carrying just under 140 000 passengers to London Bridge station, just over 110 000 to Charing Cross, and over 70 000 to Cannon Street. More than 200 trains arrive at these three stations in the hours between 7 am and 10 am, and 230 trains leave between 4 pm and 7 pm. The one signal box covers 150 miles of busy track. There are 926 signalled routes, and 547 main signals, 456 point machines, and 984 track circuits. The whole operation puts any letter of complaint from irate commuters, or harassed MP's into perspective.

The problems of doing most of the seven years' work at night or over the weekends, because commuter services had to run as normal throughout the transition period, are mind-boggling. This vast change would not have been possible in the absence of enormous cooperation and far-sighted good sense from men like Jimmy Knapp, the London organiser of the National Union of Railwaymen, and Ted Harwood, a signaller in the London Bridge box who led the negotiations on change and possible redundancy. The signaller in the new box need the same qualities of coolness and expertise as airline pilots—and their responsibilities for human life are no less. May I suggest that key representatives of commuter associations would do well to acquaint themselves with this very real modernisation, which is bringing foreign experts and potential customers to London? In days when we hear so much criticism of British industry, not least the publicly owned industry, the London Bridge development is something of a miracle, and a tribute to British skill and good industrial relations. □

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The Malaysian Rubber Research and Development Board, an agency of the Government of Malaysia, is organising a world-wide competition to find a speedy and accurate method of determining the DRC (Dry Rubber Content) of *Hevea brasiliensis* latex. A cash prize of Malaysian Dollars 50,000 (approx. £10,000) is offered. For full details and entry form, please contact:

Malaysian Rubber Research and Development Board, PO Box 508, Kuala Lumpur 01-02, Malaysia.

OR Malaysian Rubber Producers' Research Association, Tun Abdul Razak Laboratory, Brickendonbury, Hertford SG13 8NL, England.



Letters

Down's syndrome

On behalf of the Down's Children's Association, I applaud Dr Stephen Jay Gould's effort ("Dr Down's syndrome", 12 June, p 250) to abolish the antiquated and misleading term "mongol" used to refer to children and adults with Down's syndrome.

However, Dr Gould has unfortunately given a potentially wrong impression to your readers in saying that "these unfortunate children... usually die at a young age (average life expectancy is about 16 years)." First, in giving the first statement as a corollary of the second, he is using the average wrongly. The only reason why the average expectancy was so low was that in the past so many Down's babies died in the first few months of life. Though many people even then lived to quite reasonable ages, the overall average was low. This does not, however, mean that the Down's children of any of your readers can be expected inevitably to have short lives.

The facts are these: in 1939, when most Down's children were institutionalised, the mortality was very high at 87 per cent before the age of five. Between 1945 and 1955 according to Smith (1955) the mortality dropped by 40 per cent—probably because some 80 per cent of the children now lived in the community, and were not exposed to the spread of diseases in subnormality hospitals before the Second World War, to the use of antibiotics to treat the former killers bronchopneumonia and gastroenteritis, the incidence of which is also probably

reduced by improved standards of home heating and hygiene, and to the virtual disappearance of pulmonary tuberculosis in recent years.

Of the children with whom this association deals, in 14½ years we have a recorded mortality of only 4 per cent (we have some 2700 children from 23 countries currently on our files). Though of course, some children may very well have perished in the early months of life before they could be referred to us, to begin on my system of psychomotor training, dietary regulation and pre-school education, our figures indicate that mortality is no longer catastrophically high, though it is higher than in ordinary infants owing to the high incidence of cardiac conditions and a raised incidence of leukaemia in Down's syndrome.

As the late Professor Clemens Benda, for 40 years one of the world's leading authorities on the condition pointed out, if a child lived safely to the age of five, there was no obvious reason why he should not live for at least another 55 years. Only the future will tell how many of our present children will live to ripe old ages, but we have no indication so far that they will not, as many even with severe heart conditions have already survived to ages of 14 and 15 years to date.

Today our children not only have a vastly improved chance of survival, but by early treatment and training, a considerable number of them are able to reach reasonable levels of intelligence. Already a small percentage of them are attending ordinary primary

schools, and three are in secondary schools. Though the majority may not reach such heights, most are at least no longer severely subnormal, but are relatively mildly retarded.

R. Brinkworth
Down's Children's Association Birmingham

Gnaneuropeides

Four comments on peptides common to gut and brain ("Gut feelings about neuro-peptides", by Lois Wingerson, 3 April, p 16) seem in order.

First, an evolutionary view seems to make some sense of the current jumble of peptides and actions. In this view most—if not all—of the current neuro-peptides were not constructed *de novo* to fill particular functions. Rather, when a particular need arose, the most useful and readily available of a set of cellular peptides was selected to act as a specific message. One rather striking example of such a selection process, in which a given peptide is used to perform or control several, often unrelated, functions is prolactin. If our current collection of neuro-peptides has indeed had such an origin, it is not in the least surprising to find them widely distributed both anatomically and phylogenetically, filling often unrelated functional roles.

Secondly, the intensively investigated neurotransmitter function of neuro-peptides is probably the least interesting of the roles these molecules may fill. Many of the neuro-peptides and their precursors may take important roles in intermediate and long-term

I FEEL
GNAUSEOUS



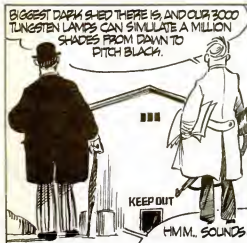
regulation of intracellular function, and regulation of intercellular processes as endocrine or para-endocrine effectors. These ideas are particularly exciting, though as yet largely unexplored.

Thirdly, the current rush of experimentation should provide solid information on the existence (or absence) of a population of functionally complementary molecules (peptide and nonpeptide) which modulate local and systemic effects of the neuro-peptides.

Finally, what can we call these molecules? They are clearly not neuro-peptides in any strict sense of the term. Perhaps the term "neuropeptide" (or GN peptide, short for gastrointestinalneural peptide) would be a useful transitional designation for this family of peptides. "Gnaneuropeide" would allow us to call them the same thing in conversation (thus avoiding yet more confusion), while making possible subtle written distinction as to their distribution and function. Lewis Carroll would approve.

Raymond J. Monnat, Jr
University of Washington Seattle

Grimbledon Down



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ENIGMA

Plus and minus

Stephen Ainley

The problem is simply to arrange as many integers as possible in a row so that the sum of any eight successive integers is positive (but as small as possible), while any 11 successive integers is negative but as near zero as possible).

A £5 book token will be awarded to the sender of the first correct solution opened on Wednesday, 16 July. Please send entries to Enigma No 65, New Scientist, King's Reach Tower, Stamford Street, London SE1 9LS. The Editor's decision is final. The winner of Enigma No 62, Missing Words, was C. R. Humm of Chesham.

Missing words Answer to Enigma 62

—ROMEO: YOYOS—

The second letters of the words strongly suggest POLIO and COROT, the third letters ALAMO and ARABY. These hints turn out right.

Chips down

Your article "South wins upper hand over chips" (This Week, p 181), on the nationwide development of "chips", is misleading. The regions shown had neither equal areas nor equal populations, so the figures were meaningless. (Lancashire may have less chip consultants than the Northern Home Counties, but because the area is only half the size, this is not surprising.) From your figures, I estimate the number of chip consultants per 100 000 heads of population in each area as follows:

| | | | |
|---------------|-----|------------------|-----|
| South East | 3-1 | West Country | 3-1 |
| East Midlands | 3-6 | N. Home Counties | 2-7 |
| West Midlands | 3-6 | N. Ireland | 2-3 |
| Yorkshire | 3-6 | London | 3-6 |
| Lancashire | 3-3 | Wales | 1-5 |

Contrary to your article, the two worst regions of England lie south of the line from the Severn to the Wash. Worse still, however, is the situation in Scotland, Ireland and Wales. These regions are frequently forgotten, as they were in your article.

Michael Kohnstamm Cardiff

Satellite switch

I read Stephanie Yanchinski's article "Thorny questions over remote sensing" with great interest (17 April, p 150).

I would draw attention, however, to a misunderstanding of the SPOT programme which appears in the last paragraph p 152.

As a matter of fact, the SPOT system will be fully compatible with the future Landsat series, Landsat-D and follow-on, as concerns reception of data by direct

reception stations. This compatibility is ensured by a joint working group NASA-CNES which was set up two years ago specifically for this purpose. This working group is functioning well and has since met at least twice a year.

We are confident that although a few adaptations will be needed to switch from one satellite to the other, the cost of these adaptations will be marginal with respect to the initial investment.

G. Brachet
Centre Nationale
d'Etudes Spatiales

Paris

Water drops

Peter Scott, in his letter of 20 March (p 957), asks for information about water droplets on his hot stove. These are called "Leidenfrost drops", after Johann Leidenfrost who first wrote about them in 1756. Early Walker described the behaviour of such drops in one of his delightful "Amateur scientist" articles in the *Scientific American* of 1977.

I do not understand Peter Scott's claim of drop stability on a convex surface. I have played about with such drops but only on a flat or slightly concave surface, but never convex.

The drops float above the surface on a vapour layer about 0.1 mm thick and they are certainly highly mobile. Their mobility arises because of the strong surface tension gradient from the underside to the upper surface of the drop. Thus fresh surface is continually created underneath

and absorbed on top. The rapid surface movement carries with it by viscous drag a stream of vapour. The stream is jetted straight upward by a stationary circular drop. If the drop moves, however, it encounters a warmer patch of plate in its direction of motion. This steepens the surface tension gradient on the hot side which enhances the vapour jet from that side, with the result that the drop is driven by the jet reaction to continue moving in the direction in which it is already going.

Jearl Walker photographed the drop with the camera in the horizontal plane of the hot surface, to observe the floating height of 0.1 mm. One can also estimate the floating height by measuring the lifetime of a drop and plugging in the thermal conductivity of the vapour layer underneath it, the temperature of the hot plate and the area of the drop. This yields a vapour layer of thickness between 0.1 mm and 0.2 mm, in agreement with visual observation of the floating height.

J. F. Allen St Andrews

The phenomenon of the water drop dancing on the hot plate I have always assumed to be due to a layer of steam forming under the drop, suspending it and cutting off the heat temporarily, so that the boiling ceases, when the drop is lowered, causing repetition of this time-consuming action.

The cleansing action of steam is well known by the commercial companies who use it to clean stonework etc on buildings.

W. E. Evans

Further to the observations of Peter Scott, I too have noticed the water drop phenomenon and speculated as to its cause.

To my way of thinking it goes something like this: a droplet of water falls on the plate and is partly vaporised. The remaining water now finds itself to be rather hot, but not in contact with the metal plate against which it normally has some small acute angle of contact. Instead, its surface tension draws it into a sphere to minimise its surface area since the surface tension even near the boiling point is its value at room temperature, and this is sufficient to pull the drop into contact with itself.

Michael Kahn

Gaborone, Botswana

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IF WE WAIT,
AFGHANISTAN
MIGHT DRIFT INTO
SIBERIA!



Not Wegener's walk

The mildly pejorative manner in which Dr Robert Muir Wood outlines Soviet opposition to drift theory is uncalled for as he seems to ignore the fact that it was not just the Russians who criticised Alfred Wegener's theory in the years prior to the Second World War ("Geology versus dogma: the Russian rift", 12 June, p 234).

Admittedly, the antagonism of Soviet scientists toward Wegener was, in part, a result of political dogma. But I think Wood under-estimates the fact that scientists, irrespective of nationality and owing to the nature of their work, will express opposition to new theories because of a fundamental aversion to having their accepted paradigms attacked.

The foundation of this kind of opposition, whether or not based on politics, is a valuable topic of historical research. Such opposition should not be the object of scorn, since scientists today are not beyond the influences which lead to prejudice. The desire for Soviet scientists to "indulge their nationalism" as Dr Wood puts it, in their scientific papers, is an accusation that can also be levelled against Dr Wood himself. The nationalism undertones of his article are unfortunate because it makes one suspicious of the otherwise enlightening information that he gives on Soviet science.

R. B. Lote Lancaster

On reading Dr Wood's article I was struck by the sentences: "Foreign travel is a privilege that is given to those who have demonstrated many years' hard work and conformism. Access to foreign conferences may be equally difficult".

Having spent 4½ years in research at two English universities, I would suggest that these statements are as relevant to the UK as the USSR.

Richard L. Patience Brighton

Letters

continued

Retort

Allopurinol

You have given prominence to the claims made by Dr W. H. S. Thomson for the effectiveness of treatment of Duchenne muscular dystrophy with the drug allopurinol, and to the sceptical attitude adopted by the Medical Research Committee of the Muscular Dystrophy Group towards Dr Thomson's claims (This Week, 12 June, p 229; 12 June, p 235).

The position of the research committee in regard both to the use of this drug, and to the justifiability of mounting fresh trials, is still what it was in 1977 when it adopted the following statement:

"ALLOPURINOL: The Research Committee of the Muscular Dystrophy Group have recently considered reports which have appeared in the medical literature concerning the treatment of muscular dystrophy with allopurinol. They are not convinced by the scientific case put forward to justify the use of this drug in treatment, and in their opinion the evidence so far available does not indicate that allopurinol has any direct influence upon the disease process. They have noted that several doctors in this country and abroad are treating patients with this remedy and the Committee are satisfied that treatment for about 12-18 months carries little risk. After careful consideration the Committee do not feel that the evidence is such to justify a costly and time-consuming trial of treatment with this remedy carried out in a large number of patients under the auspices of the Group but they are continuing to collect the information which is becoming available from many sources, and propose to keep the situation under continuous review.

The primary aim of the Committee is to find some effective treatment for muscular dystrophy and other neuromuscular diseases but at present they find the case in favour of allopurinol unconvincing. At present, the question as to whether any individual sufferer should or should not be treated with this drug is a

matter for individual decision by parents and patients in consultation with their family doctor and/or consultant."

This statement was published in the group's *Newsletter* of October 1977, and it has remained the basis on which the group has given advice to parents and to medical practitioners. Your statement (19 June) that "The Muscular Dystrophy Group advises parents to have nothing to do with Thomson's treatment" is a serious distortion of the group's advice which has always been in accordance with the final sentence of the 1977 statement.

The research committee has up to now refrained from publishing details of its reasons for doubting Thomson's claims, but since you have given prominence to them, and have described his results as "impressive" (19 June), I now feel obliged to do so.

The trial was carried out in 1976 and the published account of it can be found in the journal *Metabolism* (vol 27, p 151, by W. H. S. Thomson and I. Smith). Sixteen boys diagnosed as suffering from Duchenne dystrophy took part in the trial: there seems no reason to question the diagnoses. The trial was divided into three consecutive periods of six weeks each; every week blood samples were taken for a range of enzyme assays and biochemical measurements and weekly measurements of hand strength were made. During the first six weeks (period A) no drug was given; in period B, eight boys were given allopurinol and eight were given placebo, the tablets being allocated by a double-blind procedure, and in period C, all the boys were given allopurinol. Clinical assessments of the boys' condition were made at the end of each of the periods A, B and C.

The two results from the blind period of the trial which the authors claim as showing improvement as a result of taking allopurinol are:

(a) Seven of the eight boys on allopurinol in period B gave a higher score in the clinical assessment at the end of period B than at the end of period A, while only two of the eight boys on

placebo gave a raised score. This difference is significant ($P=0.02$ using Fisher's exact test, one-tailed).

(b) The allopurinol-treated boys showed a significant increase in hand strength during period B compared with period A, while the boys on placebo did not.

Of these two claims, the second is entirely spurious, the average apparent increase of strength being actually greater in the placebo group than in the allopurinol group (see individual values in Table 3 of Thomson and Smith's paper). It is true that in the placebo group, the increase (calculated as a percentage, and tested by a simple t test) just fails to reach significance ($t=2.00$), but this is solely because one of the boys in this group (patient 9 in Thomson and Smith's Table 3) had an exceptionally low score in the control period A and therefore showed an exceptionally large increase in period B over period A, raising the standard error of the mean to three times the value in the treated group. It is clear that the apparent strength did increase in both groups (all eight boys on the drug and all eight boys on placebo showed increases; probability of all eight boys in either group showing change in the same direction by chance is 1 in 27 or 0.008; the t test fails to show significance in the placebo group because of the non-Gaussian distribution of the values) but the difference between the two groups does not come anywhere near significance ($t=0.39$) and is actually in the wrong direction to suggest a favourable effect of allopurinol.

As regards to the clinical assessments, there is a very unsatisfactory feature in that during period B a clue was available indicating which boys were receiving allopurinol and which were on placebo. Table 3 of the Thomson and Smith paper gives, among other things, the serum urate value for each boy averaged over the six measurements in each of the periods A, B and C. As expected, this value drops in the cases where allopurinol was given: in period B all the boys receiving allopurinol show serum urate values below 3.0 mg/100 ml, while all those on placebo show values above 3.0 mg/100 ml. The

authors were thus in a position to know, before the clinical assessments at the end of the "double-blind" period B, exactly which eight boys were receiving allopurinol. The analyses were, however, done by Dr Smith and it does not necessarily follow that this information was conveyed, consciously or unconsciously, to Dr Thomson, who made the clinical assessments, but it is clear that in this essential respect the trial was not effectively double-blind as has been claimed throughout by the authors. The degree of improvement claimed does not appear to be beyond what might result from selective encouragement of patients during examination.

Thomson and Smith have published only a brief note (*New England Journal of Medicine*, vol 299, p 101) on follow-up of the patients who took part in the 1976 trial, and this is conclusive. They have not undertaken any further controlled trial of the effectiveness of allopurinol.

It is clear to me that these features justify the research committee in not having placed reliance on the evidence put forward by Thomson. An additional reason for not relying on results claimed by Thomson was that he had previously carried out a trial with a different drug (laevodopa); Thomson and Guest, *Journal of Neurology, Neurosurgery and Psychiatry*, vol 26, p 111; Guest and McLay, *British Journal of Clinical Practice*, vol 18, p 395) and had claimed substantial improvement in Duchenne patients but this could not be confirmed in subsequent blind trials (Pearce *et al.*, *British Medical Journal*, 1964, vol 2, p 915; Walton *et al.*, *ibid.*, 1965, vol 2, p 533).

These grounds for doubt, though serious, do not of course prove that the drug does no good. We have, as indicated in the statement quoted above, kept a look-out for fresh evidence in favour of, or against, allopurinol. The paper of Mendell and Weichers to which you refer (12 June; *Muscle and Nerve*, vol 2, p 53) reports a blind trial in which allopurinol had no detectable effect. This trial cannot, however, be regarded as conclusive because only a small number of patients were used; on the other hand, your

mention of a criticism that the code was broken before the end of the trial is irrelevant since the blind period was 12 months while in Thomson and Smith's trial it was only six weeks. Other blind trials, including those you mention in your issue of 12 June, have been carried out in other countries but have not yet been published; verbal reports on these to members of the research committee have not indicated improvement resulting from administration of allopurinol but clearly the published accounts must be awaited. A brief report which has appeared in the past few days (Castro-Gago *et al.*, *Lancet*, 1980, vol 1, p 1358) does suggest improvement, particularly in very young patients, but this was not a blind trial.

If carrying out a blind trial involved no diversion of research effort and no inconvenience to patients and their families, it would of course have been right to perform an independent trial of the effects of allopurinol in Duchenne dystrophy long ago. But the effort required from both sides in order to obtain a reliable result is very great and the research committee has not considered it justifiable in view of the points made in this letter about Thomson's evidence, together with the fact that trials are being carried out in other countries.

The research committee arranged some time ago that a panel (including myself) should visit Dr Thomson and Dr Smith, and, as you have mentioned, this visit was made on 13 June. Our doubts about their claims for clinical improvement in the trial were in no way allayed by our discussions; we felt that if Thomson and Smith's results made a case for a further trial, it would be on the strength of the analyses of biopsy samples reported in the addendum to their paper rather than on their clinical observations. The research committee also decided at its last meeting (in May) to hold a special meeting to discuss policy for clinical trials of possible treatments, including allopurinol, and this meeting will take place very soon.

Andrew Huxley
Chairman, Medical Research
Committee
Muscular Dystrophy Group of
Great Britain London

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Applications are invited for the following posts within the School of Biological Sciences:

Lecturers in (1) Biochemistry and (2) Applied Microbiology

QUALIFICATIONS:

Candidates will be expected to be highly qualified academically with considerable research and/or industrial experience. Applicants for post (2) should also have experience of Fermentation, Biochemical Engineering and/or Environmental Microbiology.

SALARY SCALE (UNDER REVIEW):

£8,812 - £9,092 - £9,474 - £9,878 - £10,281 - £10,686 - £11,109 - £11,540 - £11,942.

Applications with full details to:
National Institute for Higher Education Dublin,
1 Lower Grand Canal Street, Dublin 2, Ireland.
Telephone Dublin 765175.

Candidates who have responded to previous general advertisements need not re-apply as their applications will automatically receive consideration.

J. & S. SIEGER LIMITED

ASSISTANT RESEARCH SCIENTIST

We are one of the world's leaders in the research, design and manufacture of sophisticated gas detection equipment, and we are currently seeking an Assistant Research Scientist to join our research team. The work involves improvements to existing methods and the development of novel techniques for the detection and estimation of potentially hazardous gases in the atmosphere.

Applicants should have a degree, or equivalent, in Chemistry, and although not essential, preference will be given to those with a knowledge of electronics.

This appointment offers excellent career prospects, optional pension scheme, sickness benefit scheme 22 days' annual holiday, and generous assistance with re-location expenses, where appropriate.

If you are interested in joining a progressive company, please write or telephone for an application form to:-



Personnel Officer,
J. & S. Sieger Ltd.,
31 Nuffield Estate,
Poole, Dorset BH17 7RZ
Tel: 020 13 6161

SOCIALIST PEOPLE'S LIBYAN ARAB JAMAHIRIYA Faculty Openings exist at the HIGHER INSTITUTE OF TECHNOLOGY BRACK

MEDICAL LABORATORY TECHNOLOGY DEPARTMENT

Lecturers and Technicians in
Hematology, Histology, Clinical
Biochemistry, Parasitology,
Anatomy/Physiology, Medical Microbiology,
Analytical Chemistry/Instrumentation.

GENERAL SCIENCE DEPARTMENT

Lecturers and Technicians in
Physics, Zoology, Botany, Organic
Chemistry, General Chemistry,
Mathematics, English.

ENVIRONMENTAL SCIENCE DEPARTMENT

Lecturers in
Ecology, Analytical Chemistry plus Industrial
Organic Chemistry, Applied Statistics,
Microbiology, Geographer, Economist (B.A.
Environment), Sociologist (B.A.), Organic
Chemist, Physical Chemist.

Technicians in

Ecology, Biological Chemistry, Analytical
Chemistry, Environmental Engineering,
Electronics (Instrumental Maintenance).

FOOD TECHNOLOGY DEPARTMENT

Lecturers in
Food Technology (Dairy), Food Technology
(Cereals), Food Technology (Pilot Plant),
Food Engineering, Home Economics (New
product development), Food Microbiologist,
Food Analysis.

QUALIFICATIONS

Lecturers must have M.Sc. or Ph.D. plus
experience.

Technical Staff must have Technical
Certification or B.Sc. with experience.

All applicants must be fluent in spoken
English, the language of instruction.

Appointments depend on qualifications of
appointees. No age limit exists on applicants.
Fringe benefits include, medical services,
transportation and terminal gratuity.

APPLICATIONS SHOULD BE
ADDRESSED TO:



THE DEAN,
HIGHER INSTITUTE OF TECHNOLOGY,
BRACK,
P.O. BOX 12024,
TRIPOLI,
LIBYA

ENGINEERING RELIABILITY WEST COUNTRY £8200-£10800

A vacancy exists in the Reliability Engineering Section of the CEEB's South Western Region. The work involves generating plant based on coal, oil and nuclear fuels and extensive power transmission systems.

Duties include acquisition and analysis of data, the modelling of repairable systems, fault tree and decision theory as applied to engineering problems with the aim of improving plant availability, safety and efficiency. Some travel within the Region will be necessary.

The post will appeal to engineers possessing a degree or appropriate professional qualifications, and an interest in the application of probability and statistical analysis to engineering problems and to statisticians and mathematicians willing to involve themselves in plant engineering.

Terms and conditions are excellent, salary being within the above range, with generous holidays, sickness benefits and contributory superannuation scheme. The job is based on the outskirts of Bristol in modern offices. The area offers an attractive range of realistically priced houses, within easy reach of the city, open countryside and the coast. Assistance will be given with relocation to this desirable area.

Applications should be made on form AF/1, obtainable from the Personnel Manager, Bedminster Down, Bridgwater Road, Bristol BS13 8AN or by telephoning Bristol 648236 during office hours. Forms should be completed and returned quoting reference R1076/RR/79/NS by 17th July 1980.

Central Electricity
Generating Board
South Western Region



UNIVERSITY OF WARWICK Postdoctoral Research Positions in Surface Science

As a result of recent grant awards by the Science Research Council to Dr P. Woodruff, a number of research assistantships are available for work on subjects within the general area of the study of solid surfaces. These include:

(1) **Low Energy Electron Diffraction:** a new instrument incorporating channel plate multiplier amplification and a computer interfaced TV camera has recently been constructed and will be further developed and applied, mainly in the study of small molecule on metal surfaces. (A position is also available for LED theory under Dr S. W. Hildes using the CRAY computer at the SRC's Daresbury Laboratory.)

(2) **Angle-resolved synchrotron radiation photoemission:** studies of surface states using photoelectron diffraction, and adsorbed molecule sites using "ion scattered molecule" effects using a commercial instrument taking light from the new Synchrotron Radiation Source at the SRC's Daresbury Laboratory. This project is a collaborative one with Dr D. Norman of Daresbury Laboratory and is also supported by an experimental programme using laboratory light sources and theoretical computations at Warwick.

(3) **Low energy ion scattering:** shadowing studies of suboxide H₂O ion scattering signals by means of which we can be used to study adsorbate structures and the role of local neutralisation effects in ion shadowing.

All positions are for three years, starting on or after 1 October 1980 in the initial salary range of £3000 to £3725 plus US benefits. Candidates should hold or expect to hold a PhD or equivalent and have relevant experience, and should send applications as soon as possible to Dr D. P. Woodruff, Physics Department, University of Warwick, Coventry CV4 7AL. Please quote Ref. No: 4632A/NS/P.

UNIVERSITY OF GLASGOW Department of Biochemistry POSTDOCTORAL RESEARCH ASSISTANTSHIP

Applications are invited for a Postdoctoral Research Assistantship to work on the properties of bacterial membrane-bound dehydrogenases, starting on 1 October 1980. Applicants should have experience of enzymology, membranes or electron transfer systems. The salary, which is provided by an MRC grant, will be within Range 1A of the scale for Research and Analogous Staff (maximum starting salary £5725 plus USS). Applicants should send a curriculum vitae and the names of two referees as soon as possible to Dr C. A. Fewson, Department of Biochemistry, University of Glasgow, G12 8QQ, from whom further details may be obtained.

In reply please quote Ref. No. 4683N.

UNIVERSITY OF ST. ANDREWS Department of Physiology & Pharmacology

A Graduate Research Assistant

Is sought for a two year project funded by the National Kidney Research Fund concerning the biochemical and physiological characterisation of β -adrenoreceptors in isolated nephron segments and in renal tissue culture models. The post would suit a graduate in biochemistry, pharmacology or physiology. Experience in cell separation, procedures, cell culture techniques and a knowledge of membrane receptor characterisation would be an advantage but are not essential. There is a possibility that the successful candidate may register for a higher degree.

Starting salary £4400 per annum plus superannuation under USS.

Applications (two copies preferably in type-script), including a curriculum vitae and the names and addresses of three referees, should be sent by 11 July, 1980 to the Establishments Office, The University, College Gate, St. Andrews, Fife.

Technical Information Management

in a research environment

This role offers more than information gathering and dissemination. Although these tasks are part and parcel of your everyday work, other important aspects of the job will be interpreting patents and discussing the contents with research colleagues, analysing citations and masterminding a computerised file of classified patents.

Controlling information relating to health and safety laws worldwide, including customs coding and transport labelling, is a prime task undertaken by the Research Department and falls within your orbit.

To qualify, you should have a degree in Physics or Engineering and a knowledge of Chemistry. A working knowledge of German is a prerequisite and any French would be a definite advantage. Familiarity with the workings of the Patent Office is also desirable.

An excellent salary is accompanied by a full range of holidays and our international HQ is readily accessible by tube or rail.

For an application form call Roger Headley on 01-808 1050 or write to him at Gestetner Manufacturing Limited, PO Box 466, London N17 9LT.

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Registration Executive

-a chance to run your own show

Major Pharmaceutical Company

UK & Eire

Our client is a sizeable and well-respected international company, with extensive UK interests in the health care field.

The need is for a Registration Manager to take charge of a small department responsible for the registration of both prescription and OTC products in the UK and Eire.

Key features of the appointment include:

- Considerable breadth of experience, spanning a wide range of ethical and OTC products.
- Good international communications with opportunities for some travel.
- An attractive, negotiable salary (indicator around £8,500) with generous additional benefits.
- Excellent prospects for promotion on merit.

The post should prove particularly attractive to a Registration Executive of two or more years' standing in a substantial pharmaceutical company, who now feels ready and able to run his/her own show.

Our ideal candidate would be a pharmacist or life science graduate, with good experience of formulation/development work in addition to registration expertise, and the drive, maturity and communication skills of a natural manager.

The successful candidate will be based at our client's operational headquarters in a pleasant countryside location in the South where attractive low-cost housing is still available.

Please write for an application form, or telephone if you would like to discuss the appointment further before applying. Your application would be treated in strict confidence and no information would be disclosed to our client without your prior permission.

Talentmark
Leaders in Health Care Recruitment



Dr John Fullarton, Talentmark Limited,
King 'House, 5-11 Westbourne Grove,
London W2 4UA, 01-229 2266 (24 hours).



Brent Health District

CENTRAL MIDDLESEX HOSPITAL

Senior Physiological Measurement Technician

required for the Cardiology Department to supervise the overall running of the department and of the ECG Technicians.

The Central Middlesex Hospital is a University Hospital with a close association with the Regional Cardiac Centre at Harefield Hospital, and has a major pacing commitment in its own right. The work of the department also includes exercise testing, echocardiography, 24 hour monitoring and temporary and permanent pacing together with some invasive studies.

Applicants should have the appropriate qualifications and must have some hospital experience.

Application forms and job descriptions are available from the District Personnel Department, Central Middlesex Hospital, Acton Lane, London NW10.
Tel: 905 5733 ext 667.

BRENT & HARROW AREA HEALTH AUTHORITY

PHYSICAL CHEMIST FOR RESEARCH

As part of the Company's effort in marketing research-based pharmaceutical and agrochemical products, the Physical Chemistry section acts as a support unit to research and to other technical departments. Structural and physico-chemical information is provided on new compounds and upon existing products.

The Chemist will join a team, based in our Nottingham laboratories, which investigates physico-chemical properties of compounds using a wide range of analytical techniques. Some involvement in developing new experimental methods will be necessary.

Applicants, male or female, must hold a good honours degree in Chemistry, a Ph.D. or equivalent research experience. Post doctoral experience and practical knowledge of the use of radio tracers will be an advantage.

Company benefits include profit sharing, contributory pension scheme and staff purchase privileges. A generous relocation package for moving to the Nottingham area is available if applicable.

Please write or telephone for an application form from:- Tom Flower, Employment Manager (Technical), The Boots Company Ltd., Station Street, Nottingham, Nottingham NG2 55 Ext. 243

Opportunities in Advanced MOS Semiconductor Technology

Expansion of our activities in integrated circuits has led to the following vacancies for men and women:

Group Leader Pilot Production

To establish and lead a small team of engineers and operators to be engaged in the pilot production of one of the MOS technologies currently in development at the GEC Hirst Research Centre. This activity will take place in a new fabrication facility presently under construction and the Group Leader will be expected to take a leading role in creating and maintaining an efficient operating unit. Candidates for this senior position must be experienced in MOS device fabrication, have a good working knowledge of the latest processing equipment and proven management skills. A knowledge of BS9450 procedures would be an advantage.

Device Physicists

Recently qualified Graduates (good Honours degrees in Physics or Electronics) or PhD's to work on MOS device modelling, design and assessment in one of our research teams. Candidates must have a sound background in semiconductor physics and be capable of working in a multi-disciplinary team alongside LSI designers and wafer processing personnel.

Epitaxy Technologist/Physicist

An appropriately qualified graduate, probably a Materials Scientist or Physicist, for a leading position in a new project concerned with the growth of silicon on sapphire. Previous knowledge of silicon epitaxy is desirable, but significant experience in a related field of crystal growing could be acceptable.

S&C

Please write giving full details of career to date, or apply for application form, to: G. D. Prichard, Administration Manager, Ref. P/062, GEC Hirst Research Centre, Wembley, Middx HA9 7PP. Tel: 01-904 1282 Ext. 210.

SHETLAND

A medium sized family Hotel situated in the beautiful Northern part of Shetland requires the following staff.

Bar/Receptionist
(Experienced) Salary £50.00 per week

Waiter/Waitress
Salary £48.00 per week

Assistant Cook

Salary £48.00 per week
Staff will live in and will be provided with free food and accommodation.

Telephone after 6 p.m.
Mr Cole, Hillswick 207 or write
Mr Cole, St Magnus Bay Hotel:
Hillswick, Shetland.

WATFORD GRAMMAR SCHOOL

(1050 boys: 280 in Sixth Form)

has two vacancies in September, for

MATHEMATICIAN, BIOLOGIST,

both well-qualified to teach throughout the school, and with opportunity at Open Scholarship level. London fringe allowance payable (Euston 17 minutes) and possibility of accommodation on edge of open country.

These vacancies could particularly suit candidates direct from graduation or research, who are invited to enquire for further details.

Apply to Headmaster, The Grammar School, Watford WD1 7JF, giving full details of qualifications and interests, together with the names of two referees.

UNIVERSITY OF SIERRA LEONE

Njala University College

The Department of Agricultural Economics and Extension

Applications are invited for the posts of

(a) PROFESSOR and

(b) SENIOR LECTURER

Applicants for post (a) must have a PhD in Agricultural Economics or equivalent and at least seven years experience in teaching and research, preferably in Agricultural Policy and/or Extension related activities. They should also have experience in African Agricultural Problems with respect to policy decisions affecting project planning programming and budgeting. The appointee will be responsible for reorganising and planning appropriate curricula for Agricultural Economics and Rural Extension majors. Applicants for post (b) must have a PhD in Agricultural Economics and/or Rural Sociology and at least three years teaching and five years of research experience respectively. They should have a strong background in Agricultural finance and/or population related studies. Salary scales (under review): (a) L6806-L6250 per annum; (b) L6246-L6701 per annum (£1 sterling=L2-30). The British Government may provide salary supplementation in range £11532-£14160 per annum (sterling) for married appointees or £8598-£11226 per annum (sterling) for single appointees (reviewed annually—normally tax free) and associated benefits. Superannuation scheme; various allowances; biennial overseas leave; family passages; car loan. Detailed applications (two copies) with curriculum vitae and naming three referees to the Secretary, University of Sierra Leone, Private Mail Bag, Freetown, Sierra Leone, as soon as possible. Applicants resident in the UK should also send one copy to the Inter-University Council, 90/91 Tottenham Court Road, London W1P 0DT. Further particulars may be obtained from either address.

HUFFIELD INSTITUTE FOR MEDICAL RESEARCH

UNIVERSITY OF OXFORD
(on John Radcliffe Hospital site)

COT DEATH RESEARCH

A post exists for a post-doctoral physiologist or pharmacologist to work on the project "Importance of sleep and respiratory control in post-natal breathing". The work involves new studies of the respiratory and chronic recording from neural and muscular components of the respiratory system in young animals, before and after birth, in relation to the control of breathing.

Salary scale: Research Support 1A—£2408 p.a. at 56 years (under review).

Applications stating age, qualifications and giving the names and addresses of two referees should be sent to:

The Administrator, Hufield Institute for Medical Research, Headley Way, Headington, Oxford OX3 9DS.

BIRKBECK COLLEGE

(University of London)

Zoology Department

RESEARCH TECHNICIAN
(GRADE 3)

Technician required immediately to join small research team undertaking a comparative study of cell proliferation in the tissues of mouse skin in vivo and in vitro. Applicants should possess appropriate qualifications. Permanent, superannuated post. Salary on scale £3744-£6722 (under review) inclusive of London Weighting, according to qualifications and experience. To be sent to Secretary (Personnel), Birkbeck College, Malet Street, London, WC1E 7HX, or telephone 01-580 6222, ext. 529 for application forms.

Organic Chemistry

Shell Biosciences Laboratory at Sittingbourne in Kent are looking for competent people who are interested in taking an active part in SYNTHETIC ORGANIC CHEMISTRY research programmes aimed at the identification of new products for agricultural uses.

We would like to hear from you if you have some years of practical experience and enjoy the challenge of synthesising organic molecules in the laboratory. If that experience is backed by an HNC or higher qualification, it would be an additional advantage.

In exchange for your expertise and enthusiasm we can offer a good salary, pension fund, splendid location in the Kent countryside, first class sports and social amenities and possibly the finest synthesis laboratory in the U.K. Help will be given with relocation expenses where appropriate.

If you feel that you have something to offer us, please write or telephone for an application form to:

Mrs. I. Broodbank, Personnel Division (N2), Shell Research Limited, Sittingbourne Research Centre, Sittingbourne, Kent, ME9 8AG. Telephone Sittingbourne 24444 ext. 203.



Physical or Inorganic Chemist

A chemist (physical or inorganic with strong physical interest) is required for studies of the factors involved in the preparation of synthetic silicas and silicates. The work will cover such aspects as growth from solution, changes induced by processing conditions and the morphological properties of the final product, and will require application of modern colloid techniques and powder characterisation methods. Extensive contact will be maintained with the production unit and developments will be taken from bench scale through to pilot operation.

The preferred qualifications are a PhD or good class honours degree plus relevant research experience, with particular knowledge of colloid and surface chemistry and powder properties. An interest in translating basic concepts into practical realities is of major importance.

The Company operates a progressive salary and promotion policy, good superannuation and life cover benefits and where appropriate, will assist with removal expenses, legal fees, etc.

The Laboratory is conveniently situated for access to Liverpool, Chester and North Wales.

Please write for an Application Form, quoting Reference PS 693M to:

Personnel Officer
Unilever Research Port Sunlight Laboratory
Quarry Road East, Port Sunlight
Wirral, Merseyside, L63 3JW



**unilever
research**

Pharmacologist

Huntingdon Research Centre is the largest contract research organisation in Europe, involved in the evaluation of pharmaceuticals, biologicals and agrochemicals. Our excellent facilities and resources are geared to research of a high scientific content.

The Department of Pharmacology requires a recent graduate to undertake the pharmacological evaluation of novel compounds for a wide variety of activities.

One to two years' experience in industry would be an advantage.

We offer an attractive salary and excellent benefits together with relocation assistance if required. The Centre is located in pleasant countryside with excellent road and rail links to Cambridge, London and the Midlands. The area is well known for its range of attractive low cost housing.

For an application form please telephone or write to the Personnel Officer
Laboratory Sciences Division,



Huntingdon Research Centre,
Huntingdon PE18 6ES.
Telephone: Huntingdon 890431,
Extension 3251.

Huntingdon Research Centre

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Patents Officer

A vacancy exists in the Patents Branch of the United Kingdom Atomic Energy Authority at Harwell, Oxfordshire. Applications are invited from suitably qualified persons interested in training to become a Chartered Patent Agent. The minimum academic qualification is a Degree or equivalent professional qualification. Preference will be given to candidates having a background in electrical or mechanical engineering or physics. Although not essential some experience in patents work would be helpful. The successful applicant will be helped to study for the examinations of the Chartered Institute of Patent Agents and eventually for the qualifying examination for entry upon the European Patent Office List of Professional Representatives.

Harwell has a wide range of commercial interests in addition to its responsibilities in nuclear research and this is reflected in the varied subject matter of inventions and issues considered by a Patents Officer in his work. The work will involve carrying out, under the guidance of qualified Patent Agents, the normal duties of a Patent Officer, i.e. selecting inventions, drafting patent specifications, prosecuting patent applications in the UK and overseas, advising scientific and commercial staff on patent matters and other aspects of the legal protection of modern technological development.

Harwell is situated in pleasant rural surroundings, and provides its staff with many social and sporting facilities.

Salaries, which are currently under review range from £4495 to £10,220 depending on age and experience.

For application form please write to: Isabel Pratt, Personnel Department 'A', A.E.R.E. Harwell, DIDCOT, Oxon, OX11 0RA or telephone Abingdon (0235) 24141 extension 2058.

HARWELL

Research Scientists

Switzerland

We have vacancies in our Zurich Research Laboratories for a

Physical Chemist

with a good background in chemistry and spectroscopy or surface science to study basic reactions in plasma etching.

Materials Scientist

with interest and/or experience either in characterising materials and thin films for Si integrated circuit technology or preparative inorganic chemistry.

Our laboratories employ a closely interacting group of 18 graduate scientists. Both positions will involve working in contact with our main research facility in Princeton, N.J., USA. Zurich is a pleasant city, well placed for open-air activities such as mountain hiking, skiing and sailing.

Interested applicants, with a higher degree, should apply in confidence, stating experience and qualifications, to:

Director of Research,
Laboratories RCA Ltd.,
Badenerstrasse 569,
8048 Zurich, Switzerland.

RCA

UNIVERSITY OF LIVERPOOL

Department of Metallurgy and Materials Science EMBRITTLMENT OF STEELS

Applications are invited for a post doctoral Senior Research Assistant/Research Associate to carry out research on intergranular embrittlement mechanisms in ferritic steel. This topic has direct relevance to the integrity of steel components in engineering structures, particularly in the field of energy production. The project is financed for two years and is supported by the UKAEA at Harwell. The person appointed will work in association with Professor B. L. Eyre at Liverpool and Dr R. C. Edwards at Harwell. He will be expected to spend periods at Liverpool and Harwell and will have access to a range of sophisticated equipment including surface analysis instruments, micro analytical electron microscopes and servo hydraulic test machines. Initial salary will be on the scale £5,052-£6,736 per annum.

Application forms and further particulars may be obtained from the Registrar, The University, PO Box 147, Liverpool, L69 3BX, by whom completed forms should be received not later than 1st September, 1980. Quote Ref. RV/450/NS.

Department of Nuclear Medicine and Radiotopes

MEDICAL PHYSICS TECHNICIAN GRADE IV

The Department provides services to the City & Hackney District from the base unit and a sub-department at Hackney Hospital. Equipment includes four Gamma Cameras, a rectilinear scanner, a whole body counter and an emission tomograph. A work rate scheme is operated and the successful applicant will participate in the operation of imaging equipment, the preparation of radiopharmaceuticals and in radiation protection duties.

QUALIFICATIONS: ONC or equivalent (Salary leave may be granted for higher studies).

SALARY: £4030-£5004 pa. incl. LW.

Further information available from Dr A. T. Elliott on 01-499-0000, Extension 2528.

Application forms available from Miss T. Graham, Personnel Department, in writing, or telephone 01-499-0000, Extension 877. Please quote reference number P78/77 in all communications.

UNIVERSITY OF LIVERPOOL

Department of Inorganic, Physical and Industrial Chemistry

Applications are invited for the post of

DEMONSTRATOR/SENIOR DEMONSTRATOR

in the Department of Inorganic, Physical and Industrial Chemistry.

The initial salary will be within the range £4,402-£6,309 per annum. The post is tenable for a fixed term of twelve months in the first instance, from 1st October, 1980.

Applications, together with the names of three referees, should be received not later than 17th July, 1980, by The Registrar, The University, P.O. Box 147, Liverpool, L69 3BX, from whom further particulars may be obtained. Quote Ref. RV/462/NS.

BUREAU TECH (SCIENTIFIC STAFF AGENCY)

Top jobs for ONC/HNC/HND; AIMLT BSc. (Chem; Phys; Biol; Med. Lab. subjects; Electronics and Metallurgy.)

Immediate vacancies for Paint, Ink and Surface Coating Technologists. We find you the job free of charge. Tel: 01-906 6251.

Practical Product Development

c. £10,000

Home Counties

Our client is part of a major food group, which has developed modern, highly automated product handling operations at a new plant. The rapid growth and success of this young company has been the result of continued development and extension of their present product range.

They now wish to add new products to their existing range and need a Scientist with a degree in chemistry/chemical engineering/food sciences to join their product development team. You would be principally involved in developing new technologies and innovative product concepts for the '80's and '90's.

This is an opening for a progressive thinker who has the drive and initiative to put his/her ideas into action. Through probably in

your 20's, you will have experience gained in either the food or drug industry, ideally associated with dry powdered products. A knowledge of such aspects as spray/freeze drying and agglomeration would also be highly relevant.

In addition to a negotiable salary, generous benefits will be offered including relocation expenses (where appropriate).

If you are a scientist whose ability is being wasted and there is little or no scope for implementing new ideas, then we suggest you investigate further this company with a more enlightened approach to product development.

Please apply with personal and career details to position number AEP 238, Austin Knight Limited, 66a High Street, Egham, Surrey, TW20 9EY.

Applications are forwarded to the client concerned, therefore companies in which you are not interested should be listed in a covering letter to the Position Number Supervisor.



**Austin
Knight
Advertising**



NOTTINGHAMSHIRE AREA HEALTH AUTHORITY (TA)

**CENTRAL
NOTTINGHAMSHIRE
HEALTH DISTRICT**

**HARLOW WOOD
ORTHOPAEDIC HOSPITAL
ORTHOTICS CENTRE**

Applications are invited for the post of

PRODUCTION MANAGER/ BIO-ENGINEER

(Senior Scientific Officer Grade)

for this Orthotics Centre being developed on the foundation of an existing Appliance Workshop in response to recommendations of a Regional Working Party. The person appointed will be closely involved in developing the Centre, moving its base to a new site within the hospital, equipping and developing techniques. Relevant research and development will be encouraged.

Candidates should preferably be graduate Bio-Engineers with experience of production management techniques (but applications may be considered from non-graduates whose experience and background justify it). Appointment to the Senior grade requires a period of postgraduate experience; full-time postgraduate scientific study may count towards part of this. In the absence of such experience initial appointment to a lower grade may be considered.

Application form, job description and further details of this important post from the District Personnel Officer, Central Nottinghamshire Health District, Oak Bank, Crow Hill Drive, Mansfield, Notts. Tel: Mansfield (0623) 22515 Ext. 485 to whom completed application forms should be returned by 16 July, 1980.

Research into Allergic Disease

A graduate with an interest in the release of the mediators of allergic reactions is required to join a team of scientists attempting to develop a medicine for use in allergic diseases. Applicants should have a first or upper second class Honours Degree, preferably with a PhD, and must be able to demonstrate proven research ability. It is anticipated that this position will be attractive to a scientist who has a first degree in a biochemical subject and/or who has carried out doctoral level work in an appropriate aspect of biochemistry, and who wishes now to specialise in the biochemistry of allergic diseases.

The Project is based at the Biosciences Research Centre pleasantly located near Epsom Downs. A competitive salary is offered together with a non-contributory pension scheme, free life assurance and subsidised staff restaurant. Flextime is worked at this Site.

For an application form please contact the Site Personnel Manager, Beecham Pharmaceuticals Research Division, Biosciences Research Centre, Great Burgh, Wye Tree Bottom Road, Epsom, Surrey KT18 5XQ. Telephone: Burgh Heath 53344 (ext. 2207). Closing date: 17 July.

**Beecham
Pharmaceuticals**

Laboratory Technicians

At G. D. Searle we are involved in exciting research and development work with our main emphasis on our expanding Interferon project. We currently have several openings for Technicians at all levels, and would be interested to hear from those with qualifications ranging from 'O' levels to HNC in biological subjects.

Biology Department

A Technician is required to provide a tissue culture service for the Virus Research Group, and to assist in the evaluation of antiviral drugs in biochemical, cell and animal studies. Experience in microbiology would be an advantage. (Ref T/R30)

Biophysics Department

We require a Technician to investigate blood diseases at the molecular level. Experience in a biochemical laboratory is essential, preferably in the preparation and analysis of proteins and cellular membranes. (Ref T/R11)

Interferon Department

We are looking for a Technician to operate the Interferon purification process. Experience with sterile handling and protein purification techniques would be preferred. (Ref T/R15)

Junior Technician

A Junior Technician is required to assist in testing Interferon. Training will be given to those with no previous laboratory experience. (Ref JT/R15)

Sterile Products Development Department

We require a Technician to assist in the manufacture of sterile products. Previous experience is not essential. (Ref T/R04)

We offer attractive salaries which are negotiable according to age and experience, and conditions of employment include 4 weeks' holiday, contributory pension fund, private health insurance scheme, subsidised cafeteria, and sports and social club.

Male and female applicants are invited to obtain application forms from Miss D. Wardman, Assistant Personnel Officer, Searle Research & Development, Lane End Road, Sands, High Wycombe, Bucks. Tel: High Wycombe 21124 extn 3374. Please quote appropriate reference number.

SEARLE

TECHNOLOGIST

EAST MIDLANDS

£5000

We are an international company with ten factories located in the United Kingdom, manufacturing quality clay facing bricks.

At our unit in the East Midlands we are looking for a technologist either male or female to work in a technical environment. Current topics relate to aspects of quality, process control and product development.

Candidates should be aged between 22 and 27 years and possess a formal qualification in an applied science. Relevant industrial experience would be an added advantage.

Applicants must be able to demonstrate the ability to work individually and within a team.

This position is expected to provide excellent opportunities for career development of the type associated with a sound public company. Benefits include assisted membership of BUPA, a contributory pension scheme and free life assurance.

Please write in the first instance giving details of age, experience and qualifications to:

R. Taylor, Manpower Development Manager, Ibstock Building Products Limited, Aldridge, West Midlands W59 8TB. Alternatively telephone Mrs. Kathleen Harris on Aldridge 52211 (reversing charges) for an application form.

IBSTOCK

UNIVERSITY OF GLASGOW Departments of Chemistry and Virology

Applications are invited from

CHEMISTS

with several years of postdoctoral experience to join a small group involved in the study of a potential antiviral compound. The work is funded by the National Research and Development Corporation and will be jointly directed by Dr J. F. Szilagyi (Department of Virology) and Dr D. D. MacNicol (Department of Chemistry). The successful applicant will be engaged both in the isolation and the structural elucidation of the active agent. Experience in separation techniques and spectroscopic methods is essential.

The appointment will be for one year, starting on 1 September, 1980, or soon after. Salary will be within Range 1A of the salary scales for Research and Analogous Staff (£5052-£7073), with placement at a point appropriate to age and experience.

Applicants should send, as soon as possible, a curriculum vitae and the names and addresses of two referees to Dr D. D. MacNicol, Department of Chemistry, University of Glasgow, Glasgow, G12 8QQ.

In reply please quote Ref. No. 4681N.

THE ROYAL VETERINARY COLLEGE University of London

Division of Paraclinical Studies

DEPARTMENT OF MICROBIOLOGY & PARASITOLOGY

VIROLOGY TECHNICIAN

with some experience and/or a degree in Microbiology required from July for 18 months in the first instance to assist with grant-aided studies of the pathogenesis and immunology of herpesvirus infections of animals, particularly the horse. Opportunity for further training if required.

The appointment will be at Grade 3 or 4, according to qualifications and experience.

Salary scales: £4374 to £4872 pa
£4728 to £5325 pa
inclusive of London Allowance

Application form obtainable from Assistant Secretary (Personnel) The Royal Veterinary College, Royal College Street, London NW1 0TU (01-387-3896 Ext. 244)

TECHNICIAN (GRADE 3)

required in Department of Chemistry, University of Reading, mainly to assist technician in charge of Physical Chemistry Laboratory in preparing the laboratory for undergraduate classes and giving a service to undergraduates during classes. Training in assistance to research groups in Physical Chemistry will be given. ONC, SLT or equivalent qualification desirable. Salary in scale £3594-£4092 per annum (under review). Apply with full details of qualifications and experience and the names of two referees, quoting Ref: TS28A to Personnel Officer, University of Reading, Whiteknights, Reading RG6 2AH.

JUNIOR MEDICAL LABORATORY SCIENTIFIC OFFICER

GRADE A or B, required to help in laboratory investigation of patients with skin inflammation. Please send details of qualifications, previous experience, and names and addresses (including telephone numbers, if possible) of two referees, to Dr A. Kolba Black, Professorial Unit, Institute of Dermatology, Homerton Grove, London E8 6BA.

Mass Spectroscopist

Shell Research Limited have a vacancy for an experienced chemist, specialising in organic mass spectrometry, to work in the Analytical Chemistry Division of their Biosciences Laboratory at Sittingbourne Research Centre in Kent.

You will lead a team providing an analytical service to the Research Centre and specialising in the operation of high resolution mass spectrometers with associated data processing equipment. The instruments available include a Kratos/AEI MS 30 double beam, double focusing mass spectrometer and an ultra-high resolution Kratos/AEI 50 mass spectrometer, both coupled to gas chromatographs and linked to a VG Multispec data handling system. Procurement of further equipment is under consideration.

You should be a graduate, preferably PhD, with several years involvement in high performance mass spectrometry and with experience of soft ionisation techniques and MS data processing. The post requires the ability to incorporate new ideas and technology to improve the technical capability of the facility.

We will offer a competitive salary and assistance will be given with relocation expenses where appropriate. You will be able to join our pension fund, enjoy flexible working hours and work in well-equipped laboratories situated on our 450 acre farmland site. There are also excellent facilities for sports and social activities. Please write or telephone for an application form to:

Shell Research Limited, (N2) Recruitment Division, PNE1/21, Shell Centre, London SE1 7NA. Telephone 01-934 2948.



RESEARCH CHEMIST

FILTRONA LIMITED

leading suppliers of filters and instrumentation to the tobacco industry, require a RESEARCH CHEMIST for their laboratories in Wembley.

The work involves basic and applied research into tobacco smoke filtration using a range of modern analytical and physical techniques.

The successful candidate will be in his/her early twenties, have an honours degree in chemistry, and be able to demonstrate a high degree of practical ability. An interest in mathematical modelling would be considered an advantage.

A highly competitive salary is offered together with opportunities for advancement.

Benefits include 21 days holiday, a superannuation scheme with free life assurance, a subsidised restaurant, and a sports and social club.

For further details and an application form, please write to:

Mr P. Andreas
Group Leader, Research
Filtrona Limited
30/31 Abbey Estate
Mount Pleasant
Alperton
Wembley, Middlesex HA0 1RE.

filtrona



Research Chemist

Burmah-Castrol Company is mainly known in the U.K. for its range of Castrol Lubricants and Burmah Petrols.

A vacancy has arisen for a Research Chemist with both practical and theoretical experience of fundamental chemical analysis to work in the Analytical Section of the Refinery Research Laboratory. Reporting to the Section Head responsible for analytical instrumentation, the job holder will have responsibility for developing laboratory analytical techniques, related to Refinery and other Company products. This analytical work is of increasing importance because of health and safety considerations.

Applications are invited from Graduate Chemists with the necessary experience in Chromatography (HPLC, Gas and Liquid, Thin Layer) and Spectroscopy (Ultra Violet and Infra Red).

This position would suit a Chemist with the correct theoretical background, in his or her middle or late twenties.

Salary will be linked to both qualifications and experience but forms only part of extremely attractive terms and conditions of employment to include four weeks' holiday, non-contributory pension scheme and other large company benefits. Consideration will be given to relocation expenses where appropriate.

Applications from both men and women are welcome.

Please write or telephone for application forms to
Mr. M.A. Sharpe, Personnel Manager,
Burmah Castrol Company, Ellesmere Port,
South Wirral, Cheshire.
Telephone No. 051-355 3737 Extn. 2066.



ELECTRONIC ENGINEERS AND PHYSICISTS

Outstanding Research Opportunities

THORN EMI's Central Research Laboratories at Hayes, Middlesex have many firsts to their name. Here was developed the first high definition broadcast television system, the first airborne reconnaissance radar, the first stereo disc system and, more recently, the first CT X-Ray Scanner for which its inventor Dr. Godfrey Hounsfield, was awarded the Nobel Prize.

In order to achieve more firsts we currently need Electronic Engineers and Physicists with a good degree and an innovative approach to advanced research.

The successful applicants will be involved in stimulating projects in one or more of the following areas:-

MICROPROCESSOR CONTROL SYSTEMS
HIGH FREQUENCY/MICROWAVE SYSTEMS
SIGNAL AND IMAGE PROCESSING
OPTICAL ELECTRONICS
POLLUTION SENSING
SOLAR MATERIALS
MAGNETIC MATERIALS

VIDEO TECHNOLOGY
VACUUM DEVICE TECHNOLOGY
THERMOPLASTIC MATERIAL APPLICATIONS
DIGITAL AND COMPUTER BASED SYSTEMS
ULTRASONIC UNDERWATER IMAGING
HIGH VOLTAGE ELECTRICAL SYSTEMS
AND THEIR ASSOCIATED ELECTRONICS

Salary and career development properly reflect the Company's very high regard for creative scientific brainpower and experience. Equally generous fringe benefits are provided including relocation expenses where appropriate.

If you can demonstrate a record of success in your career to date and wish to be considered for one of these vacancies, write in confidence to: Neil Robotham, Personnel Department, THORN EMI Limited, 135 Blyth Road, Hayes, Middlesex or telephone him on 01-573 3888 ext. 3016.

THORN EMI

CENTRAL
RESEARCH
LABORATORIES

THE UNIVERSITY COLLEGE OF WALES

ABERYSTWYTH
DEPARTMENT OF PHYSICS

Applications are invited for the post of

RESEARCH ASSOCIATE

within the Upper Atmosphere Group to work on a project involving analysis of data from the European Incoherent Scatter (EISCAT) facility and ancillary experiments in investigations of atmospheric gravity waves.

Candidates should have a PhD in Atmospheric Physics or equivalent research experience and an interest in computer modelling would be an advantage. The post has been funded by the SRC until September 1982 at a salary within the Range £5052 to £6299 per annum (interim scale effective 1 April 1980).

Applications, including curriculum vitae and the names of two referees should be sent by 1 July 1980 to Professor Sir Graeville Berron, FRS, Department of Physics, University College of Wales, Penglais, Aberystwyth, Dyfed.

M.R.C. CLINICAL RESEARCH CENTRE
(NORTHWICK PARK HOSPITAL)
WATFORD ROAD, HARROW,
MIDDX. HA1 3UJ

TECHNICIAN/ JUNIOR TECHNICIAN

There is a vacancy for a Technician/Junior Technician to assist in studies of the interaction between the anaesthetic gas nitrous oxide and vitamin B12. The work is financed by a grant from British Oxygen Company and will last for two years. The post will be administered by the Division of Anaesthesia of the Clinical Research Centre, Medical Research Council, but the studies are collaborative between the Divisions of Anaesthesia, Aematology and Comparative Medicine.

The main task will be the controlled exposure of rodents to trace concentrations of nitrous oxide but the successful applicant will be encouraged to take over some of the laboratory assays of B12 activity.

Potential applicants should first discuss this appointment with Dr J. F. Nunn (01-884 5311 Ext. 2405) before applying to Mr A. Mariner (Ext. 2885) for an application form, quoting Ref. 1912/BOC. Closing date 18 July, 1980.

THE AUSTRALIAN NATIONAL UNIVERSITY

Applications are invited from suitably qualified persons for appointment to the following positions:

RESEARCH SCHOOL OF PHYSICAL SCIENCES DEPARTMENT OF SOLID STATE PHYSICS FELLOW/SENIOR FELLOW

The University wishes to make a tenured appointment in 1981 at the level of Fellow or Senior Fellow in the field of high resolution optical spectroscopy of solids. The Department has two lasers (c.w. and pulsed) with associated dye lasers, and is well-equipped for studies in all aspects of solid state spectroscopy (EPR, Mossbauer, ultraviolet, visible and infra-red). There are also research programmes in metal physics and the thermal properties of condensed matter. There are supporting mechanical and electrical workshops and excellent facilities for materials preparation.

CLOSING DATE: IS AUGUST 1980.

SALARY on appointment will be in accordance with qualifications and experience within the following ranges: Senior Fellow \$A26 622-\$A31 030; Fellow \$A19 845-\$A26 586. Present exchange rate: \$A1: UK 49p.

TERM OF APPOINTMENT—five years with possibility of reappointment to retiring age.

Reasonable appointment expenses are paid. Superannuation benefits are available for applicants who are able to contribute. Assistance with finding accommodation is provided for an appointee from outside Canberra. The University reserves the right not to make an appointment or to make an appointment by invitation at any time. Prospective applicants should first obtain further particulars from the Association of Commonwealth Universities (Apsu), 36 Gordon Square, London WC1H 0PF.

UNIVERSITY OF WARWICK RESEARCH TECHNICIANS

The Department of Biological Sciences has several vacancies for Research Technicians in the classical development, animal development, microbiology and virology groups. Successful candidates will work under the direction of a senior scientist on specific research projects using modern experimental techniques and instrumentation of molecular biology, e.g. nucleic acid biochemistry, gene cloning and tissue culture. The posts are for contract periods of one to five years. Applications are invited from graduates and others with appropriate qualifications in biochemistry and/or microbiology. Salary on either the Technician Grade 2B scale: £3881-£3849 per annum or Grade 3: £3594-£4092 per annum, depending on qualifications and experience. Apply by letter giving full details to the Personnel Office, University of Warwick, Coventry CV4 7AL, quoting Ref. No. 42/T/80/F, within six days of the appearance of this advertisement.

CENTRAL PUBLIC HEALTH LABORATORY DIVISION OF MICROBIOLOGICAL REAGENTS AND QUALITY CONTROL

JUNIOR MEDICAL LABORATORY SCIENTIFIC OFFICER

Candidates must have two science 'A' levels, OGC in Sciences or a suitable degree.

Work could include Bacteriology, Serology and Virology and training for necessary exams and state registration after an appropriate time.

Applications to Personnel Officer, Central Public Health Laboratory, Colindale Avenue, Colindale NW9, Telephone 01-205 7041.

unilever research **Mutagenicity Assistant**

(Ref. CH-550A)

Our Environmental Safety Division has a vacancy for a Mutagenicity Assistant. The job holder will be involved in the testing of materials of interest to Unilever for bacterial mutagenicity. This will involve the organisation and implementation of the Ames test and the utilisation of other tests to meet special requirements.

Candidates for this post must have a degree in the Biological Sciences or preferably in Genetics/Microbiology.

The Colworth Laboratory is located on a very attractive 1200 acre country estate ten miles north of Bedford. Salaries and fringe benefits are at a level expected of a large international company and include assistance with moving expenses where appropriate.

Please write giving details of career history and quoting reference number to:-

Miss J. Kenny,
Recruitment & Career
Development Manager,
Unilever Research,
Colworth Laboratory,
Colworth House,
Sharnbrook,
Bedford MK44 1LQ.



**THE GRASSLAND RESEARCH INSTITUTE
HURLEY, MAIDENHEAD, BERKS SL6 5LR**

COMPUTER PROGRAMMER

To work within the Computing and Data Section of the Bio-mathematics Division. The section is responsible for computer services in support of the Institute's research programme, which is concerned with improved animal production from grass and other forage crops.

The officer appointed will develop new software for general use and for application in agriculture and biological research. Computing facilities include a Honeywell 725 terminal link to the ICL 4/72 system at Rothamsted and a local PSP8E, FORTRAN being the most widely used language.

QUALIFICATIONS: An appropriate degree, HNC or equivalent with experience or an honours degree and a good general knowledge of computer science. Experience on a scientific or technical environment an advantage.

The appointment will be in the **SCIENTIFIC OFFICER** or **HIGHER SCIENTIFIC OFFICER** grade.

SALARY: SCIENTIFIC OFFICER £3591-£5486
HIGHER SCIENTIFIC OFFICER £5097-£8737

Point of entry dependent on qualifications and experience. At least 5 years relevant post-qualifying experience would be required for the higher grade.

Applications to the **Secretary** with curriculum vitae and the names of three referees and quoting **9/G/52** by **16 July, 1980**.

Organic Chemist

Searle Pharmaceuticals is a division of the multinational company G.D. Searle. At our modern factory in Morpeth, Northumberland we manufacture a range of mainly ethical products for both home and export markets.

Due to internal re-organisation a vacancy has arisen for a chemist to join a small and very successful team working on the technical supervision and improvement of the chemical processes used in the manufacture of our drug products.

This is a challenging position involving work on the plant and in the laboratory and will provide an excellent opportunity for a bench chemist with 2 to 3 years experience of practical synthetic organic chemistry to develop his or her skills within the fields of manufacturing and project management. You should be educated to 1st degree level, but higher qualifications could be advantageous.

The work entails close involvement with the chemical production plant so a double-day shift-system, Monday to Friday is in operation. An attractive salary/benefits package including shift allowance will be offered and assistance with re-location is available if required.

Please write in the first instance to:-
Mr. C.M. Whitney, Personnel Manager,
Searle Pharmaceuticals, Whalton Road,
Morpeth, Northumberland. Tel: Morpeth 514311.



SEARLE

MEDICINES TESTING LABORATORY

Microbiologist - H50/S0

Applications are invited for a position within the Microbiological Section of the Medicines Testing Laboratory to join a team of scientists engaged in microbiological investigation of pharmaceutical products.

Applicants should possess a 1st or 2nd Class Honours Degree in the Biological Sciences (or equivalent) with specialist knowledge of Microbiology.

In addition, the successful candidate is expected to have had a minimum of 5 years industrial experience preferably in the pharmaceutical industry.

The appointment will be either on the scale of the scientific civil service, or depending on qualifications and experience.

Application forms and further details are obtainable from:-

Dr E. B. Mullock,
Head Designate,
Medicines Testing Laboratory,
The Pharmaceutical Society of Great Britain
36, York Place, EDINBURGH EH1 3HU.

Industrial Chemist

Metalworking Lubricants

Over the last decade our client has established a leading position in its specialist marketing field. Now, in a calculated bid to extend its base, the company is commencing a new product venture aimed at capturing a substantial share of the growing cutting oils and rust preventive market.

As a first step, it is necessary to appoint an experienced industrial chemist to supervise the technical aspects of the operation.

The man or woman appointed will be responsible for the development of formulations for a wide range of applications and will therefore possess specific expertise. Formal qualifications are desirable, but a sound practical knowledge

of the specialty is of key importance, as is knowledge of manufacturing and process/quality control.

The post is laboratory based, but considerable customer liaison will be necessary. Salary will fully reflect the value placed on the appointment, and a wide range of valuable benefits includes a company car and appropriate relocation expenses. There will be considerable opportunity for career development.

Please write, with brief relevant details, to Position Number ABI 564, Austin Knight Limited, Tricorn House, 51-53 Hagley Road, Edgbaston, Birmingham B16 8TP.

Applications are forwarded to the Client concerned, therefore Companies in which you are not interested should be listed in a covering letter to the Position Number Supervisor.



Austin Knight Advertising

Creative Engineers and Scientists

The New Product Development Unit is expanding in new areas of development. The work provides challenging opportunities in problem solving, working in multi-disciplinary teams developing the telecommunication products of the future.

Vacancies exist for Engineers or Scientists with knowledge of electronics. Candidates should have an appropriate degree and at least 2 years' related experience.

The jobs are located on the Herts/Essex border. Competitive, attractive salaries and good fringe benefits are offered.

To apply write or telephone: Christine Hall, NPDU, Standard Telephones and Cables Limited, 3 West Road, Harlow, Essex CM20 2BT Tel: 0279 39851 Ext. 221.

STC

HEAD PLANT BREEDER

Our company is seeking the employment of a professionally qualified Plant Breeder, preferably with PhD, to plan and develop a specialist plant breeding section within our agricultural research and development programme domiciled at Kimihia Research Centre, Lincoln, Christchurch, New Zealand.

The principal responsibilities will be to initiate and progress wheat and herbage programmes and there will also be some involvement with other crops.

The scientist we wish to attract should have the capability to determine and direct our total plant breeding programme and delegate, as appropriate, responsibility to our agronomy staff.

This is a new position in a rapidly developing area of the New Zealand Seed Industry. Our expansion in plant breeding will necessitate the erection of new buildings alongside our existing research facilities and the successful applicant will be involved in planning these new premises.

This is an exciting opportunity for a scientist with ambition to join a progressive large national company which has made a commitment to develop an effective plant breeding programme.

There will be ample opportunity for travel and a generous salary and benefits will be negotiated.

Applications will be treated in confidence and should be directed in writing to NZ Manager, Grain & Seed Division, Wrightson NMA Limited, PO Box 939, Christchurch, New Zealand including personal details, qualifications, work experience and references.



UNIVERSITY OF DUBLIN
Trinity College

EXPERIMENTAL OFFICER

(Department of Physics)

Applications are invited for the above post from candidates with an appropriate degree or equivalent recognised technician qualification. Candidates should have experience in the design, operation and repair of advanced electronic equipment, preferably that used in Physics Departments.

Salary Scale:— £5202-£6409 pa (under review).

Appointment will be made at a point commensurate with the qualifications and experience to date of the successful candidate. There is a non-contributory pension scheme.

Application forms may be obtained from:

The Staff Office,
West Theatre,
Trinity College,
Dublin 2.

Tel. 772941, ext. 1775.

The closing date for receipt of applications will be Wednesday, 23 July, 1980.

HARROW SCHOOL

Senior Laboratory Technician

for School Chemistry Laboratory.
Salary £4900 pa. Accommodation to be discussed.

Apply in writing to Mr T. G. Harney, Harrow School, 5 High Street, Harrow, Middlesex HA1 3HP, or telephone 01-864 1924 afternoons or evenings.

FIELD CENTRE

requires adaptable, energetic kitchen assistants. Full board and lodging, low wages and opportunities to join in all centre activities. Apply: Preston Montford Field Centre, Montford Bridge, Shrewsbury.

Three shift chemist

There are vacancies in our Quality Control Laboratory for Chemists to work on a three shift system. The work involves chemical analysis and testing of raw materials, semi-processed solutions and finished products. Applicants should have an HNC/ONC or equivalent in chemistry and ideally have a background in analytical chemistry. Familiarity with GLC, IR, UV/Visible procedures and an understanding of classical analytical techniques would be an advantage.

The positions attract competitive salaries and

company benefits include four weeks annual holiday, contributory pension scheme and free life insurance.

For further details please write or phone:—
Pamela Sabel,
Personnel Officer,
Travenol Laboratories Ltd,
Caxton Way, Thetford,
Norfolk. Telephone:
(0842) 4581 ext 328.



Travenol—saving life is our business

PRODUCT DEVELOPMENT EXECUTIVE

c. £8000

A vacancy exists in the Research & Development Department of John Player & Sons for a Scientist as a 'Product Development Executive'. In this role he/she will be a member of a team developing new products and improving existing ones and will be particularly concerned with the physical and chemical properties of tobacco which contribute to the specification of a quality product.

The job will require establishing close working relationships with Brand Management, Consumer Research personnel as well as groups within Imperial Tobacco Limited's research organisations.

The successful applicant is likely to be a University graduate in chemical or applied science, and have had several years postgraduate research experience associated with natural products in a Consumer Products Industry.

There is a range of Company fringe benefits including assistance with re-location expenses where appropriate.

Applicants are invited to write with full CV to Richard Ashley, John Player & Sons, Nottingham.

Junior Biochemist/ Biochemist

Smith Kline & French Laboratories Limited is the U.K. subsidiary of the international SmithKline Corporation whose interests include the research and manufacture of pharmaceuticals. The company's Research Institute presently operates in Welwyn Garden City, but over the next few years will be moving a few miles to newly built laboratories at The Frythe, Welwyn.

We now have a vacancy for a Biochemist in our Metabolic Biochemistry Department to work in the field of drug metabolism studies. Candidates should be studying or have studied for an HNC/D in Biological Sciences or equivalent. Previous laboratory experience is essential, preferably in Biochemistry. And candidates should hold an appropriate Home Office licence. Day release facilities for further education will be available where appropriate.

We offer a competitive salary on a progressive incremental scale together with discretionary annual bonus, free life assurance and BUPA membership, subsidised cafeteria and an excellent Sports and Social Club.

Please write or telephone for an Application Form to:
Kate Viscardi, Recruitment Administration Officer,

SMITH KLINE & FRENCH LABORATORIES LIMITED

Mundells, Welwyn Garden City,
Herts AL7 1EY.

Tel: Welwyn Garden City 25111 ext 4650.



SK&F

a SmithKline company

THE UNIVERSITY OF MANCHESTER

Barclays Chair in Microprocessor Applications in Industry

A generous endowment from Barclays Bank Limited has enabled the University to establish in the Department of Computer Science a Chair in Microprocessor Applications in Industry. Applications are invited for the Chair, the holder of which will be concerned with the application of computers and computer techniques in industry, with particular reference to microprocessors. The other Chairs in the Department are held by Professors Tom Kilburn, F. H. Sumner, D. B. G. Edwards and Derrick Morris. Particulars of the appointment may be obtained from the Registrar. Applications (2 copies, one suitable for photocopying), giving full details of qualifications, experience, research, etc, and the names and addresses of 3 persons to whom reference may be made, should be sent to The Registrar, The University, Manchester M13 9PL by 18 July, 1980.

ICI Central Toxicology Laboratory

Technician-Mobile Pulmonary Function Laboratory

The Central Toxicology Laboratory provides advisory and experimental services to ICI Ltd for the control of toxic hazards in manufacturing processes and in other fields of growing importance, such as the development of pesticides and food additives.

A vacancy has been created for a Technician to operate, on a daily basis, a mobile Clinical Pulmonary Function Laboratory. The Unit, which is based at the Central Toxicology Laboratory at Alderley Park, consists of a Hewlett Packard 47804A system capable of automated measurements of ventilation, distribution and diffusion.

The appointee should have at least two years practical experience of pulmonary function testing and must possess appropriate professional training.

As extensive travel to ICI sites throughout the UK will be involved, a current clean driving licence is essential. The ability to

communicate and co-operate effectively at all levels with Company medical, nursing, scientific and technical staff will also be required.

In addition to salary, ICI also operate a Productivity Bonus and Profit Sharing Scheme.

Anyone interested in applying for this vacancy should telephone or write (quoting reference T/CFFU/DPE) to:-



Miss S C Carson,
Personnel Officer,
ICI Central Toxicology
Laboratory,
Alderley Park,
Nr. Macclesfield,
Cheshire.
Tel: Alderley Edge 582711,
ext 194.

Overseas candidates should only apply if they have a planned visit to the UK within the next two months

Closing date for applications: 31st July 1980.

UNIVERSITY OF STRATHCLYDE

Applications are invited from graduates (any discipline) for a

RESEARCH ASSISTANTSHIP

in the
**DEPARTMENT OF
CIVIL ENGINEERING**

working with a multi-disciplinary research team on the challenging problems associated with underwater maintenance activities (Project MASS).

Candidates should have a sound knowledge of computer programming. Preference will be given to the successful candidate to help him/her acquire the necessary background information. The project is concerned with underwater navigation systems in and around offshore structures. The successful candidate will be required to construct software for a divers tracking system. Opportunity will be available to register for a higher degree.

Project MASS was initiated by the University of Strathclyde as a positive contribution to underwater maintenance research and is supported by a major grant from the Science Research Council. The work has the active backing of many companies in the offshore industry.

Appointment will be until 30 June, 1982.

The appointment will be on Range 1A of the national salary structure for research and analogous staff, on the salary scale £5052-£8769 per annum, with placing according to qualifications and experience. Supervernation benefit.

Application forms and further particulars (quoting R29/80) may be obtained from the Academic Appointments Officer, University of Strathclyde, Royal College Building, 204 George Street, Glasgow G1 1LW, with whom applications should be lodged as soon as possible.

UNIVERSITY COLLEGE LONDON

Protein Technology
Programme
**BIOCHEMICAL or
CHEMICAL ENGINEER**
postgraduate or postdoctoral, and
PHYSICAL BIOCHEMIST

postgraduate or postdoctoral, to join a programme supported by SRC grants totalling £200,000. Successful candidates will join a team studying the effects of shear on proteins during processing steps such as ultrafiltration and examining the kinetics of protein precipitation, a situation, a central operation of large-scale protein and enzyme recovery and fractionation. Applications to Dr P. Dunnill, Dept. of Chemical and Biochemical Engineering, University College London, Torrington Place, London WC1E 7JE.

TECHNICIAN/ RESEARCH OFFICER

required to assist in our Cellular Pathology Laboratory on projects involving the study of changes during ageing in the body and in cells and tissue and their relation to cancer production. Experience in tissue culture, and cytogenetics useful. HNC/Degree required.

Salary range £4500 to £6500. For further information and application form please write or telephone Miss S. M. Hurley, Imperial Cancer Research Fund, Lincoln's Inn Fields, WC2A 3QT, 0200 ext. 365.

COMMONWEALTH AGRICULTURAL BUREAU

Post of Director

Commonwealth Bureau of Plant Breeding and Genetics
Cambridge, UK

The vacancy arises from the retirement of Dr R. H. Richens, Director of the Bureau since 1964. His successor will be expected to join the Bureau as soon as possible after appointment.

The main work of the Bureau is to collect, analyse and disseminate to research workers throughout the world information on the genetics, cytology and breeding of agricultural crops. This is done principally through the publication of Plant Breeding Abstracts, which comprises some twelve thousand abstracts per year summarising papers in over thirty languages. Like all others in the CAB series, PBA is replicated in machine-readable form and is accessible on-line through the DIALOG system.

Duties
The Director is responsible for the content of PBA and related services and for maintaining the high standards for which the services are known and respected worldwide.

Qualifications
Applicants should have a degree in a science relevant to plant breeding and genetics, and be able to demonstrate a broad comprehension of current developments in plant breeding in both temperate and tropical countries. The ability to write accurate, correct and concise English is essential, and substantial experience in scientific editing very desirable. A knowledge of at least one European language other than English is recommended, and the ability to participate constructively in new developments in information science will be helpful.

Salary
In the scale £2165 to £13 343 with merit awards to £12 880. The starting salary will be related to qualifications and experience.

Applications
Application forms and full particulars can be obtained from the Executive Director, Commonwealth Agricultural Bureaux, Farnham House, Farnham Road, Slough SL3 3BN, UK. Closing date: 1 August, 1980.



Tayside Regional Council

PUBLIC ANALYST'S DEPARTMENT

SENIOR ASSISTANT ANALYST

(Ref: 115/80)

£6174 - £7731

Location: Public Analyst's Department,
24 Mains Loan, Dundee

Applications are invited for the above post from Chartered Chemists and Members of the Royal Institute of Chemistry with at least 3 years experience of working in a Public Analyst's laboratory or similar analytical laboratory. The Department is housed in recently completed purpose-built accommodation in the centre of Dundee. Placing on the above salary scale will be dependent upon experience. Closing date for receipt of applications is Friday, 18 July, 1980.

Application forms for the above post are available from and returnable to the Head of Personnel & Management Services, 15 Albert Square, Dundee - telephone Dundee 23281 Ext 3881. Removal and relocation expenses are available in certain circumstances for staff appointments. Candidates of either sex may apply.

Innovative Chemists for Product Development

The ARDROX DIVISION of BRENT CHEMICALS INTERNATIONAL has two opportunities for high calibre chemists to work on the development of speciality chemicals.

ARDROX products are sold throughout the world to major aerospace and general industries, particularly those associated with transport and power generation. Our customers demand the highest standards and this provides a real challenge in the area of product development to meet the changing needs of a high technology market.

The successful applicants will join a specialist team located at Bourne End, Bucks, where our new central R & D Laboratories are nearing completion.

Applicants should have a chemistry degree or equivalent and a period of at least three years practical industrial experience in the applied chemistry field. A practical approach to problem solving is essential.

ARDROX offers a good salary, commensurate with experience and qualifications and a company environment where salary and promotion are strongly linked to performance and initiative.

Please apply in writing in the first instance to:



Mrs M. Swinburne,
Group Personnel,
Brent Chemicals
International Limited,
Ridgeway Estate,
Iver, Bucks.
Quoting ARDROX R & D.



Plant Pathologists

Plant Protection Division is the focal point in the ICI Group for the research, development and marketing of crop protection chemicals on a world-wide basis. We have a vacancy in our Plant Pathology Section at Jealott's Hill for a person to lead a research team which aims to find new chemical treatments for the control of plant diseases.

This post will suit an honours graduate with a PhD degree, and research experience involving the growing of experimental plants (in glasshouse or field) and their infection by pathogenic organisms. He or she will have a good knowledge of basic chemistry and biochemistry, and an interest in pesticide chemistry and structure/activity relations. Familiarity with agricultural practices and pesticide usage, experience in the evaluation of fungicides in glass house or field, and knowledge of disease epidemiology will be an advantage.

This vacancy is very similar to one advertised in March; all previous applicants will be considered for the current vacancy and need not re-apply.

We can offer an attractive salary and there are good prospects for career progression. We will help with relocation expenses where appropriate.

If you are interested in applying for this vacancy, please write or telephone for an application form to: Mr D. Spence, Personnel Officer, ICI Plant Protection Division, Jealott's Hill Research Station, Bracknell, Berkshire. Tel: Bracknell 24701. Please quote reference number 80/2/PP.



Plant Protection
Division

RESEARCH IN HOVERCRAFT CONTROL

If you have a good honours degree in engineering or applied science, preferably with experience in aerodynamics and servomechanisms, and you are capable of pursuing a programme of experimental and theoretical research, we would be pleased to hear from you.

We need a Research Assistant to work in the field of hovercraft response, using the Cranfield whirling-arm facility. Appointment would be for two years and you would be expected to register for a PhD degree.

Salary in the range £4402-£6399 pa.

For further details, ring Dr Peter Christopher on 0234 750111, ext. 227 or 229; or write to:

The Employment
Office (ref. 446/
B) Cranfield
Institute of
Technology,
Cranfield,
Bedford
MK43 0AL.



COLLEGE OF
AERONAUTICS



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AGRICULTURAL RESEARCH COUNCIL POULTRY RESEARCH CENTRE

King's Buildings
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EH9 3JS

STATISTICIAN

Applications are invited for a post in the Scientific Officer / Higher Scientific Officer grade in the Statistics Department at Roslin, Midlothian. The person appointed will be a member of a team of three statisticians collaborating with other departments on design and analysis of experiments. The holder of the post will be encouraged to engage in individual research in so far as it contributes to the programme of the Centre. Duties will also include liaison with the Computing Department where excellent facilities are available.

Qualifications: 1st or 2nd Class honours degree in Statistics or Mathematics, with at least two years relevant experience for entry at the higher level.

Salary: in scale £3591-£5486 (Scientific Officer), £5097-£6737 (Higher Scientific Officer) per annum with placements according to qualifications and experience. Non-contributory pension scheme, 20 days annual leave (Scientific Officer) 22 days annual leave (Higher Scientific Officer).

Application forms can be obtained from the Secretary at the above address. These forms should be completed and returned to him not later than 25 July, 1980.

SENIOR RESEARCH BIOLOGIST ISCHAEMIC HEART DISEASE

We are seeking an experienced biologist to initiate and develop a new project devoted to the discovery of drugs of value in the therapy of Angina. This project will form part of the programme of a large existing cardiovascular team, based at our Nottingham laboratories, which is presently actively engaged in the hypertension field.

Ideally applicants, male or female, will have post-doctoral experience in an area of cardiovascular pharmacology and an appreciation of the biochemical aspects of the disease. Although industrial experience in the pharmaceutical industry is desirable, personal ability and the ability to lead and motivate a research team are more important.

Benefits are those expected of a large successful Company and include profit sharing and staff purchase privileges.

Salary will reflect experience and generous help with relocation to the area is available, if applicable.

Please write or telephone for an application form from: Tom Flower, Employment Manager (Technical), The Boots Company Ltd., Station Street, Nottingham. Nottingham 56255 Ext. 243

Senior Analyst

(Analytical Method Development)

Due to expansion of our company and the acquisition of new products, we are looking for a Senior Analyst to work on development of new analytical methods and stability testing, reporting directly to the Quality Control Manager.

The successful applicant will be a graduate with 3 years analytical experience, involving method development. Knowledge of traditional methods of analysis is essential and familiarity of GC and HPLC would be advantageous.

If you have the relevant experience and are familiar with the concepts of stability testing, or wish to develop your interest in this area, then this is the job for you.

If you would like an application form please ring Basingstoke 57272 or write to: — Eileen Barnes, Optrex Limited, City Wall House, Basing View, Basingstoke, Hants.

Optrex

UNIVERSITY OF BRADFORD POSTGRADUATE SCHOOL OF PHYSICS

RESEARCH ASSISTANT

Applications are invited for the above 3-year post which entails collaboration with academic staff in the design, implementation and commissioning of the central system for a large magnetic spectrometer to be installed at the SRC Laboratory at Daresbury in Cheshire. The successful applicant's prime area of responsibility will be to write programmes for control and running of the spectrometer in real time. The successful candidate will be a graduate in a relevant field (Physics, Electrical Engineering, Computing) and experience in real time programming would be an advantage. Salary within the range £4402-£5389 according to age, experience and qualifications.

Application forms obtainable from the Registrar, Post Ref: PY/RA/D-SAC/INS, University of Bradford, Bradford, BDY 1DP. Closing date asep.

THE UNIVERSITY OF LEEDS DEPARTMENT OF BIOCHEMISTRY

Applications are invited for a post of

POST-DOCTORAL RESEARCH FELLOW

In the above Department to work on projects in the protein sequencing unit. The appointment will be made for a fixed period of up to four years.

The successful applicant will be required to assist in the day to day running of the sequencing facilities and participate in on-going or new research projects. Salary in the range £5052-£6736 on the IA Scale for Research and Analogous Staff (£5052-£6736). Informal enquiries may be made to Dr B. C. Fritter, Department of Biochemistry (Telephone 5232 3175) ext. 7180.

Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference number 8013/E. Closing date for applications 1 September, 1980.

UNIVERSITY COLLEGE, LONDON Department of Physics and Astronomy

MULLARD SPACE SCIENCE LABORATORY Holmbury St. Mary, Dorking, Surrey

Applications are invited for

Two Postdoctoral Research Assistantships

financed by the Science Research Council for work on the analysis and interpretation of (1) solar X-ray Spectroscopic data now being gathered by a polychromator aboard the NASA (Orion) spacecraft; (2) magnetospheric data gathered from a low energy particle analyzer aboard the NASA GEOS spacecraft. The appointments will commence on 1 October, 1980, or as soon after as possible. Salary within the range £5052-£7746 plus USS membership.

Applications, with curriculum vitae and the names of two referees, should be sent to: Professor R. L. F. Boyd, CBS, PMS, at the above address.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (University of London) Kappel Street WC1E 9HT

MEDICAL LABORATORY SCIENTIFIC OFFICER (HISTOLOGY)

The Department of Medical Histology is engaged in expanding research projects into certain important histological diseases and has a busy post-graduate programme.

The successful applicant for the medical laboratory scientific officer post should be suitably qualified and state registered, and experience in histopathological techniques would be an advantage.

Salary for this post is in accordance with Whitley Council scales plus Inner London Weighting. Send full curriculum vitae and names of 2 referees to: F. C. Ball, Assistant Secretary by 17 July, 1980. Further details may be obtained from the Chief MLSO on 01-436 8634 Ext. 345.

UNIVERSITY OF WARWICK POSTDOCTORAL RESEARCH IN LEED THEORY

To work with Dr B. W. Holland on an SRC supported project on LEED theory. It is intended to make improvements to existing LEED programs, to optimise them for use on the CRAY computer at the SRC's Daresbury Laboratory, and to analyse experimental data (particularly from Dr Woodruff's group in the Department) with a view to surface structure determination. The position is for three years starting as soon as possible. Initial salary up to £5725 per annum on the Research Range IA scale: £5052-£8769 per annum. Candidates should hold, or expect to hold a PhD and have relevant experience. Applicants giving a full curriculum vitae and the names and addresses of two referees should be sent to Dr B. W. Holland, Department of Physics, University of Warwick, Coventry CV4 7AL, England, as soon as possible. Please quote Ref No: 42/A/80/F.

UNIVERSITY COLLEGE LONDON Department of Chemistry POSTDOCTORAL RESEARCH ASSISTANT

Applications are invited for a post of Postdoctoral Research Assistant to work with Dr I. Paterson on novel applications of organosilicon and silyl enol ether chemistry in organic synthesis. Appointment will be for two years commencing in October 1980 with salary in range £5052-£5725 plus £740 London Allowance: USS.

Preliminary enquiries or applications with curriculum vitae and names and addresses of two referees should be sent to Dr Ian Paterson, C/o Professor M. L. McGlashan, Chemistry Department, University College London, 20 Gordon Street, London WC1H 9AJ.

Medical Oncology Department

Charing Cross Hospital (Fulham)

Applications are invited from suitably qualified persons, preferably with experience in radiotherapy, to join an expanding team developing monoclonal antibodies to tumour markers.

The post is initially for 3 years. Salary according to age and qualifications. Enquiries to Mr G. Rawlins, on 01-748 2040 ext. 2992.

For an application form, please telephone the Personnel Department, on 01-748 2040 Ext. 2992.

There are a few things worth representing. Medicine is undoubtedly one of them.

Our clients are among the major pharmaceutical and scientifically based companies. They are currently seeking to fill a wide range of well paid positions for Medical and Technical Representatives throughout the U.K.

If you are scientifically qualified and are aged between 22-35, and feel you have the ability to communicate technical information, then ring us now on 01-831 6471 or 01-404 4598.



Scientific Staff Consultants
50 Lincoln's Inn Fields London WC2

UNIVERSITY OF EAST ANGLIA

Norwich Applications are invited for a TEMPORARY LECTURESHIP IN ENERGY

in the School of Environmental Science. The appointment will be for one year, and will be tenable from 1 October, 1980, or as soon as possible thereafter. Applicants should have a scientific or engineering background with post-graduate experience in a relevant field and be able to contribute to the honours course Energy, Materials, and Society and appropriate sections of the Preliminary programme. Salary will be within the range £3052-£3699 (under review) plus USS benefits.

Applications (one copy only) giving full particulars of age, qualifications and experience, together with the names and addresses of three persons to whom reference may be made, should be lodged with the Establishment Officer, University of East Anglia, Norwich NR4 7TJ (telephone 0603 56161, ext 2126) for further particulars may be obtained, not later than 14 July, 1980. No forms of application are issued. In naming three referees you are particularly requested to give only the names of those who can immediately be approached.

BIRKBECK COLLEGE (University of London)

INSTRUMENT-MAKER/ TECHNICIAN GRADE 3

Varied and interesting work in well-equipped workshop providing a central service for College Science departments. Applicants should have at least five years' experience, with a recognised trade apprenticeship or ONC, O/CII or equivalent qualification. Salary scale £4374-£4872 including London Weighting. Excellent conditions of service. Apply, stating age, qualifications and experience, to Assistant Secretary (Personnel) (NS), Birkbeck College, London WC1E 7HX, or telephone 01-580 6622, ext 529, for application forms.

TECHNICIAN (GRADE 4)

required in Department of Microbiology, Virology Section, University of Reading. To prepare material for practical classes, assist research workers and manage a small laboratory equipment and services. Knowledge of techniques used in Virology and Immunology an advantage. Possibly some handling of laboratory animals. Salary according to qualifications and experience in scale £3348-£4545 p.a. (under review). Apply for further details, quoting Ref. T-330A, to Personnel Officer, University of Reading, Whiteknights, Reading RG6 2AH.

Gallenkamp is a leading company in the laboratory equipment field, and a member of the Fisons Group.

Sales Correspondent

Scientific Equipment EC2

We are looking for a young person who is technically orientated and who has 'A' levels in science subjects to train in our Agency Sales Department to advise and quote for Olympus microscopes. This is an interesting position and there is the possibility of promotion either to Technical Sales Representative for a person interested in this work, or to other more senior positions within the Company.

We offer 4 weeks holiday and flexitime. Other benefits are as associated with a large Company. The job is located at our modern head office building near to Moorgate and Liverpool Street stations.

Please phone S. Bramble (Mrs), Recruitment Officer, A. Gallenkamp and Co. Ltd., P.O. Box 290, Technico House, Christopher Street, London EC2P 2ER. Tel: 01-247 3211.

Gallenkamp

SCIENTIFIC EDITOR

The Society for General Microbiology requires someone to assist in the editing and production of its two learned publications, *The Journal of General Microbiology* and *The Journal of General Virology*. An interest in scientific publishing and information exchange is essential and some previous publishing experience would be an advantage. Applicants should preferably have a degree in microbiology, biochemistry or a related science, a good command of English and a keen eye for detail. Starting salary will be £4002 or £4729 on a scale rising to £7416. The person appointed would be expected to work in Reading, Berkshire, and to live in the neighbourhood.

Applications, accompanied by a curriculum vitae and the names of two referees, should be sent to: Miss H. J. Bower, Harriet House, 43 London Road, Reading, Berkshire, RG1 5AS.

The London Hospital (Whitechapel)

MEDICAL LABORATORY SCIENTIFIC OFFICER

A vacancy has occurred in the blood group serology and transfusion department of this busy teaching hospital. The position is ideal for an intending candidate for the special examination in blood transfusion of the IMLS. Excellent tutorial and practical facilities available. Opportunity to take part in out of hours rota.

Salary scale: £4523-£6215 inclusive. Application forms and job description available from Personnel Services, Holland Wing, The London Hospital, Whitechapel E1 1BB. Telephone: 01 247 5454 Ext. 380. Closing date: 20 July, 1980.

KINGSTON POLYTECHNIC School of Chemical and Physical Sciences

SENIOR TECHNICIAN T4

Required to be responsible for an advanced spectroscopy laboratory. This is a specialized area including an M59 and an M53076 high resolution mass spectrometer the latter having an on-line gas chromatograph and a computerized processing data system. Other equipment includes a laser Raman spectrometer and an interferometer. Candidates should have had relevant experience and be able to display initiative and enthusiasm plus a particular interest in mass spectrometry. Salary range T4 £5558-£6174 inclusive.

SENIOR TECHNICIAN T3/4

A Senior Electronics technician is required to be responsible for the building and maintenance of the School's electrical/electronic equipment. The complexity of the equipment requires the technician to be familiar with high level analytical instrumentation and to be able to diagnose faults accordingly. The post offers the opportunity of designing and building equipment and of bringing new ideas and technology into the department.

Salary range T3/4 £4971-£6174 inclusive.

Application forms from Assistant Registrar (Personnel), Kingston Polytechnic, Penryn Road, Kingston upon Thames KT1 2EE, 01-549 1346.

THE UNIVERSITY OF MANCHESTER

LECTURER IN PHYSIOLOGY

Applications are invited for this post (available from 1 October, 1980) from candidates with a higher degree in Physiology or related subjects. The post involves qualifications registrable in UK. The appointee will teach medical, dental and science students. Excellent research facilities exist. Salary range per annum £2652-£10 464. Supernannuity, particulars and application forms (returnable by 11 July) from the Registrar, University of Manchester, M13 9PL. Quote Ref: 134/80/NS.

SENIOR LABORATORY TECHNICIAN

for September, 1980, to be responsible for School Physics Department, comprising five laboratories, two demonstration rooms and a workshop. Accommodation could be available. Apply in writing giving details of previous experience to Head of Science, Merchant Taylors' School, Sandy Lodge, Northwood, Middlesex HA6 2HT.

Information Science in a research orientated retail environment

Sainsbury's is one of the country's leading and fastest growing food retailing organisations and at our Blackfriars headquarters we maintain extensive research laboratories which are probably the most modern of their kind in Europe. The laboratories also provide a scientific/technical information service in such areas as science and technology, engineering, personnel and management.

Assistant Technical Information Scientist

To assist in providing a general technical information service, This will involve close liaison with research bodies, government departments and other companies, and the acquisition and dissemination of relevant information throughout the Company.

A degree or equivalent in a relevant science is required plus, ideally, a good knowledge of food science and technology, management techniques or marketing or retailing methods. Experience of information work is particularly desirable.

Librarian

Required for the library information section to provide an efficient service including such aspects as cataloguing and classification of publications, provision of specific information on literature available and general maintenance of all library systems and storage facilities. The successful applicant will be one of a team of three, the others being Information Scientists.

A professional qualification as a Librarian is desirable, coupled with at least two years' experience in a special or industrial library. A good working knowledge of basic sciences, ideally including food technology, management techniques or marketing and retailing methods is required.

Both appointments offer good salaries and attractive benefits including interest free season ticket loans, subsidised restaurant, share option and profit sharing schemes.

For an application form please write to Valerie Sladden, Recruitment Officer, J. Sainsbury Ltd., Stamford House, Stamford Street, London S.E.1. Tel: 01-921 6104.

SAINSBURY'S MORE OF A CHALLENGE. MORE OF A CAREER.

UNIVERSITY OF LIVERPOOL
ENVIRONMENTAL ADVISORY UNIT

Technician (Grade 3)

to assist with investigating the mobility of metals in reclaimed heavy metal contaminated ground. Duties include chemical analysis of soil and vegetation samples using atomic absorption spectrophotometry also maintenance of field experiments. Candidates must possess OMC or appropriate equivalent as minimum qualification and three years laboratory experience. Previous experience of similar work desirable but not essential.

This post is initially for one year, extendable to three.

Salary in range £3094-£4092 pa.

Application forms may be obtained from the Registrar, The University, PO Box 147, Liverpool L69 3EX. Quote Ref: RV/671/86.

Inner London Education Authority
SOUTH LONDON SCIENCE CENTRE
Wilson Road, London SE5 8PD
Tel: 01-761 2224

TECHNICIAN GRADE 6 for Biology/Chemistry

The successful applicant will be involved in the preparation of experiments related to laboratory-based courses for science teachers and technicians and advising them on all aspects of Biology and Chemistry apparatus and practical work in the South London area.

Applicants should have HNC, City & Guilds Pt. II or equivalent and nine years experience (including training period).

Salary scale: £4884-£5832 plus £780 London Weighting.

Application forms are available from and returnable to the Centre within 14 days of the appearance of this advertisement.

UNIVERSITY OF GLASGOW

Department of Natural
Philosophy

RESEARCH ASSISTANTSHIP/ LECTURESHIP IN PHYSICS

The University of Glasgow wishes to expand its research on gravitational wave detection and offer a special appointment in the Department of Natural Philosophy for work in this field. For the initial period of two to three years, the post will be supported by a research grant made by SRC to the University in support of the work of Professor R. W. P. Drever and his group and at the end of this period it will be taken over by the University as a tenured lectureship. The research programme includes development and use of gravitational wave detectors using laser interferometry and other techniques. Correlated observations made with gravitational wave detectors at Glasgow and at California Institute of Technology are envisaged. A suitable applicant might be an experimental physicist or electrical engineer with at least three years postdoctoral experience. Previous work on highly sensitive or high precision experiments in any field could be an advantage.

The initial appointment will be within the salary range of £5053-£7410 of Range 1A of the Research and Analogous Staff scales with placing according to qualifications and experience. Appropriate superannuation scheme will apply.

Further particulars may be obtained from the Director of the University Court (Room 1B), University of Glasgow, Glasgow G12 8QQ, with whom applications (eight copies), giving the names and addresses of three referees, should be lodged on or before 25 July, 1980.

In reply please quote Ref. No. 4459/IN.

MEDICAL REPRESENTATION

The ethical medical industry places great importance on those whose task it is to introduce, discuss, encourage and stimulate interest in their products with pharmacists, GPs and hospitals. A career with great challenge and undeniable interest is offered to people with Science degrees, medical or laboratory background. Thorough training, generous salaries and substantial benefits are offered and the long-term prospects are excellent.

*Phone or write to:

Keith Robinson,

DAVID WHITE ASSOCIATES
LTD.

(Medical Recruitment Consultants),

34 Kingsway,

WC2.

Tel. 01-495 7711

HIGHER SCIENTIFIC OFFICER

required to join a team conducting research on industrial air pollution problems. Candidates will be expected to have previous industrial experience, preferably in the coal carbonisation industry. A background knowledge of modern methods of chemical analysis would be an advantage.

Desired qualifications are a good degree or equivalent in chemical engineering and chemistry or fuel technology etc.

Preferred age: 25-30 years.

Salary: £5,087-£6,400 p.a.
Apply in writing giving details of qualifications and experience to: The Secretary, British Carbonisation Research Association, Wingerworth, Chesterfield, Derbyshire, S42 6JS.

UNIVERSITY OF EDINBURGH

INSTITUTE OF ANIMAL GENETICS

Applications are invited for a Ministry of Agriculture, Fisheries and Food postgraduate studentship to undertake research into the causes and inheritance of DYSPONDROPLASIA IN POULTRY, and its association with leg weakness in fast growing birds.

The studentship will be tenable from October 1980 for a period of two years. A PhD degree. Candidates should hold or expect to obtain a good honours degree in Biology or Agriculture or a Veterinary qualification.

Further particulars may be obtained from The Secretary, Institute of Animal Genetics, West Main Road, Edinburgh EH9 3JN to whom applications should be sent as soon as possible. Please quote reference 7011.

Imperial Cancer Research Fund Laboratories, London

SCIENTIST HEAD OF COMPUTER UNIT

We require a scientist with substantial computing experience in a field relevant to the work of the Fund and with a broad knowledge of computer techniques. The person appointed will in addition to developing their own research, be responsible for the computing services of our laboratories, scientific liaison with computer users and user instruction. The main computer is a recently installed DEC 2050 supervised by a computer manager with a staff of five programmer/analysts and an operator. Relevant research areas include, in particular, statistical and epidemiological analysis, as well as applications for artificial intelligence, image analysis and data base management in the biomedical field.

After an initial probationary period, this appointment will be of unlimited tenure. Salary range is expected to be £10 412-£12 564 plus £740 London Weighting, but may be extended depending on age, qualification and experience.

Enquiries and applications should be sent to Dr W. F. Bodmer, Director of Research, Imperial Cancer Research Fund, Lincoln's Inn Fields, London WC2 by 31 August, 1980.

UNIVERSITY OF STRATHCLYDE/UMIST
Applications are invited from
Chemists or Physicists
for an
SRC POSTDOCTORAL RESEARCH ASSISTANTSHIP
in the
DEPARTMENT OF PURE AND APPLIED CHEMISTRY

The research programme will combine computer modelling with small angle neutron scattering experiments on block copolymers of different Dr. R. W. Rickard varying solvent conditions. The work will be jointly supervised by Dr. R. W. Rickard and Dr. R. F. T. Soaps, UMIST. Computer modelling, which will involve visual display work, will be carried out at UMIST whilst small angle neutron scattering will be supervised from Strathclyde and will entail use of facilities at AERE Harwell and ILL Grenoble.

Appointment for three years from 1 October 1980 on Range IA of the national salary structure for research and analogous staff. Commencing salary within the range £2051-£2725 per annum. Superannuation benefits apply.

Applications and curriculum vitae, naming two referees (quoting R30/80), to: Dr R. F. T. Soaps, UMIST, Department of Pure and Applied Chemistry, University of Strathclyde, Glasgow, G1 1LE.

ST. THOMAS' HEALTH DISTRICT (TEACHING) LONDON SSI

FULL OR PART-TIME

MEDICAL LABORATORY SCIENTIFIC OFFICER

To work in the Cytology Section of the busy Royal Postgraduate Medical School on the preparation and screening of cervical smears and other material for the detection of malignant and non-malignant conditions. The Department is situated within the new premises of St. Thomas' Hospital. Relevant experience preferred but training available to other suitable candidates. Grade and salary at age 21 or over and other qualifications and experience £3008-£6215 p.a. (inclusive), 1990 pay award pending.

St. Thomas' Hospital, The House of Parliament is close to rail, tube and bus services. Facilities include canteen ticket loan scheme.

TELETYPE (The Personnel Department, "Thomas" Hospital, London SE17 7TE. Telephone (01) 928 9282 Extension 371 for application form and job description.

ROYAL POSTGRADUATE MEDICAL SCHOOL (University of London)

The Department of Histochemistry

requires a RESEARCH ASSISTANT

to work on morphological aspects of peripheral neuroendocrine regulation. Sophisticated techniques of histochemistry and/or transmission electron microscopy would be an advantage. Opportunity for a higher degree.

Apply with full curriculum vitae to Dr J. Pollak, Royal Postgraduate Medical School, 155 Du Cane Road, London W12 0HS.

BRIGHTON POLYTECHNIC FACULTY OF NATURAL AND LIFE SCIENCES

RESEARCH ASSISTANTS

C3765-6306

Vacancies exist in the following Departments:

Applied Chemistry
Applied Physics
Biology

Details of posts and application forms from Administrative Officer, Faculty of Natural Sciences, Brighton BN1 9QJ, to whom they will be returned by Thursday, 17 July 1980.

UNIVERSITY OF MANCHESTER

LECTURERS IN PHARMACY

Applications are invited for the above posts (tenable immediately) from honours graduates in Pharmacy, preferably with a higher degree. One post is in Pharmacology and the other primarily in Pharmacognosy and the successful candidates will be required to teach and carry out research in Physical Pharmacy or Pharmaceutical Technology, and Pharmacognosy respectively. Initial salary within the range £5052-£10 404 per annum. Superannuation. Particulars and application forms (returnable by 18 July) from the Registrar, The University, Manchester M13 9PL. Quote Ref: 145/80.

UMIST CORROSION RESEARCH POSTGRADUATE AND POSTDOCTORAL APPOINTMENTS

The Corrosion and Protection Centre is one of the world's major establishments conducting research into theoretical and applied aspects of corrosion control.

Research posts are available for suitably qualified scientists and engineers. All applications and enquiries should be addressed to Professor G. C. Wood, Corrosion and Protection Centre, UMIST, PO Box 88, Manchester M60 1QD.

KING'S COLLEGE LONDON RESEARCH TECHNICIAN GRADE 5

Applications are invited from suitably qualified persons interested in carrying out research into thrombosis and haemostasis under the direction of Professor G. V. R. Born, FRS. The appointment, funded by the British Heart Foundation, is tenable for 2 years. Applicants must be experienced in researching and able to assist in research utilising human blood, IMLs or equivalent techniques. Relevant experience. Salary £5037 p.a. inclusive, 37½ hrs week, Monday to Friday. Five weeks annual holiday. Superannuation scheme. Apply in writing with full details to the Head Clerk (Ref: 221763), King's College London, Strand, WC2R 2LS.

UNIVERSITY COLLEGE SCHOOL

BIOLOGY LABORATORY TECHNICIAN

Salary according to age, qualifications and experience. Apply by letter to the Science Master, University College School, Cranford, Hampstead, London NW9 6XH.

Laser Technician

Applications are invited for the above post the main task of which is checking out electronic ultra high speed cameras using a dye laser. This will closely involve working with development on projects where the use of a dye laser is necessary and the successful applicant will have the responsibility of running and maintaining this laser. The ideal candidate will probably be over 25, qualified to ET5, and have probably been employed as a physics technician.

In return we offer a varied and interesting job, a competitive salary, four weeks annual holiday, free meals in our staff canteen and usual fringe benefits.

For application form apply to:

**Ann Jones
Personnel Officer
John Hadland (P.L.) Ltd
Newhouse Road
Bovingdon
Herts HP3 9EL
Telephone: Hemel Hempstead 832525**



KING'S COLLEGE LONDON POST IN ORGANIC CHEMISTRY

Organic chemists are invited to apply for a post as Technician Grade 5 to work in collaboration with Professor C. B. Reese on the chemical synthesis of oligo- and poly-nucleotides. The appointment, supported by SRC funds, is tenable for one year from October 1980. Salary £5037 per annum inclusive five weeks holiday. Superannuation scheme.

Applicants should send curriculum vitae and the names of two referees to: Professor C. B. Reese (Ref: 221777/NS), King's College London, Strand, W.C.2R 2LS.

ST THOMAS' HOSPITAL MEDICAL SCHOOL (University of London) LONDON SE1 7TE

Department of Morbid Anatomy ELECTRON MICROSCOPE Junior (B) ML50

required in a modern well equipped laboratory, which provides research and diagnostic services. Previous experience an advantage. Salary on Whitley Council scale according to age, qualifications and experience.

Apply in writing, with two references to the Head Clerk (Ref: 221763). For further information ring 01-928 9282 ext 376.

St Mary's Hospital Medical School (University of London) Norfolk Place, London W2 1PG

JUNIOR MEDICAL LABORATORY SCIENTIFIC OFFICER

required for the Medical Unit to assist in a vast programme of research in the curriculum.

Candidates should have GCE 'A' levels in Chemistry and one other science subject in addition to 3 'A' levels (or equivalent).

Commencing salary aged 17 £2295 + £206 p.a. London Allowance (under review) and day release for further study.

Apply, The Secretary, at above address with full curriculum vitae and names and addresses of two referees. Please quote Ref NS/BU/CM.

UNIVERSITY OF READING AUDIO-VISUAL TECHNICIAN (GRADE 5)

Required for the School of Education, London Road, to operate and maintain a service to the School. Experience of closed circuit television equipment essential. ONC or equivalent qualification desirable.

Salary in scale £4257-£4974 per annum (under review). Apply for further details quoting Ref: TS31A to Personnel Officer, University of Reading, Whiteknights, Reading RG6 2AH.

TEAM LEADER

SYNTHETIC ORGANIC CHEMISTRY

As a result of internal promotion a vacancy now exists for a Team Leader in our Process Research and Development Department. This department is a vital part of R & D and its two main functions are discovering potential marketable ethical pharmaceuticals and preparing large quantities of these products for our drug discovery programmes.

The job involves leading a 5/6 person team of experienced organic chemists and technicians whose main aim is to discover good chemical syntheses for potential marketable products — work which is both intellectually demanding and varied.

Applicants, of either sex, should have a PhD and a minimum of 5 years post-doctoral experience in synthetic organic chemistry. At least 3 years should have been spent in industry and it is equally important that applicants have experience of directing the work of others.

Conditions of employment include a competitive salary, flexible working hours, an active Sports and Social Club, pension facilities and assistance with re-location where appropriate. We can offer pleasant rural surroundings with relatively low cost housing, also access to major Midland cities.

For an application form please contact:
Miss Cathy Mason, Personnel Officer,
Fisons Limited, Pharmaceutical Division,
Bakewell Road, LOUGHBOROUGH,
Leicestershire LE11 0QY.
Tel: 0509 66361
Reference number RD100/NS



Science Research Council

ROYAL GREENWICH OBSERVATORY

SCIENTIFIC OFFICER/ HIGHER SCIENTIFIC OFFICER

There is a vacancy in the Observatory's TIME DEPARTMENT for a SCIENTIFIC OFFICER/HIGHER SCIENTIFIC OFFICER to join a small team responsible (jointly with the University of Hull) for the development and operation at Herstmonceux of a Satellite Laser Ranging System which will be used for collaborative projects with university groups etc. investigating the Earth's rotation, satellite orbital theory, geodesy and geophysics.

Applicants should have or expect to obtain in 1980 a good honours degree in Physics or a related subject. In addition candidates should have an interest in and ability to contribute to the scientific programme of the project. Knowledge of electro-optical systems and/or the use of digital computers in instrument control will be an advantage. Candidates for HSO must have at least 2 years' post-graduate experience.

The post is permanent and pensionable.

Starting salary, which will depend on qualifications and experience: SO from £4210 to £4844 on a salary scale currently rising to £5486; HSO £5097 to £5486 on a scale currently rising to £6737 (the salary scales are currently under review).

Application forms and further information can be obtained from Mr N. Jones, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, East Sussex BN27 1RP (Tel. 032-181 3171 Ext 206) and should be returned by 31 July, 1980.

The Queen's University of Belfast

LECTURESHIP IN SPACE & ASTROPHYSICS

Department of Pure and Applied Physics

Applications are invited for the above position (tenable from 1 October, 1980). The successful applicant will be expected to carry out research in astrophysics and must be prepared to undertake teaching in the Department in both general physics and astronomy.

Current programmes of the Astrophysics Research Group include studies of stellar atmospheres and interstellar gas physics. There is strong emphasis on the development and application of instrumentation for programmes of ultraviolet and optical astronomical spectroscopy using both balloon-borne and ground-based telescopes. Related satellite observations are being made using the international Ultraviolet Explorer. The person appointed will be expected to play an important role in expanding the experimental and/or theoretical activities of the group within this general field of research.

The salary scale is £2085-£10 885 per annum with contributory pension rights under PSSB or USS. Initial placing on the scale will depend on sex, qualifications and experience.

Further particulars may be obtained from the Personnel Officer, The Queen's University of Belfast BT7 1NN, Northern Ireland. Closing date: 31 July, 1980. (Please quote Ref. 80/NS).

UNIVERSITY OF GLASGOW Department of Chemistry POSTDOCTORAL RESEARCH ASSISTANTSHIP

Applications are invited for the above SRC funded post directed towards exploring new strategies in the design and synthesis of chiral and achiral inclusion compounds. The post will appeal to X-ray crystallographers with experience in single-crystal work. Department has excellent computing and automatic diffractometer facilities. The appointment will be for one year with salary in range 1A of the scales for Research and Analogous Staff (£5602-£5725) with placement depending on age and experience.

Curriculum vitae, list of publications, and names of two referees should be sent to Dr D. D. MacNicol, Department of Chemistry, University of Glasgow, Glasgow, C12 8QQ.

In reply please quote Ref. No. 4682N.

UNIVERSITY OF BRISTOL

RESEARCH ASSISTANT IN ENGINEERING MATHEMATICS

The Department of Engineering Mathematics has a vacancy for an SRC funded Research Assistant to work in Dr T. T. Bickley on the development of optimal control methods for tidal power schemes. The appointment will be for two years starting 1 September, 1980, or by arrangement, and the salary will be in the range £4402 to £4399 (under review). Preference will be given to candidates with some post-graduate experience and some knowledge of optimal control techniques. Applications should be sent to Dr T. T. Bickley, Department of Engineering Mathematics, University of Bristol, Bristol BS8 1TR.

LABORATORY TECHNICIAN

required for Physics Department in this Independent Sixth Form School. Salary according to qualifications and experience, based on scales operative in local authority.

Appointment from 1 July or 1 September. Apply in writing to: The Headmistress, St. Allen's Girls' School, London SE22 6TE. Please include a detailed curriculum vitae and names and addresses of two referees.

UNIVERSITY OF ST. ANDREWS

Department of Biochemistry & Microbiology

Applications are invited for a

LECTURESHIP IN MICROBIOLOGY

In the Department of Biochemistry and Microbiology (tenable from 1 October 1980). Candidates should have qualifications in Microbiology and will be expected to take part in microbiology research and teaching in the Department.

Salary at appropriate point on scale £5052 to £10 484 (under review), starting salary probably not above £7410, plus U.S.

Applications (two copies preferably in triplicate) with the names of three referees should be lodged by 15 July, 1980 with the Establishments Officer, The University, College Gate, St. Andrews, Fife, from whom further particulars may be obtained.

UNIVERSITY OF BIRMINGHAM

Department of Genetics
POST-DOCTORAL RESEARCH FELLOW

Applications invited for above-year MRC-funded post tenable from October 1980 to investigate structure and function of replication genes of broad host range plasmid RK2. Experience with DNA sequencing, mutant characterisation and gene cloning preferred.

Salary on the RPIA scale £5052-£8685 (under review) plus superannuation. Maximum starting salary £5725.

Further particulars available from Assistant Registrar (Science & Engineering), PO Box 363, Birmingham B15 2TT, to whom applications (three copies) including curriculum vitae and naming three referees, should be sent by Friday 18 August 1980.

Please quote ref: NSLS.

MEDICAL RESEARCH COUNCIL HARWELL SCIENTIST

required for the Secretariat of the Council's Committee on Protection against Ionising Radiations. Duties include the reporting and organising of meetings and appreciation of the literature on a wide variety of topics in biology, medicine and physics. Preference will be given to someone qualified in a biological subject. There will be opportunities for theoretical, experimental or epidemiological work on the effects of ionising radiation. Candidates should have a good honours degree and three years of relevant research experience. Salary within the range Grade II £6065-£8215, Grade III £4275-£5484 (as at Interim Pay Award, 1 April, 1980) according to age and experience. Applications with curriculum vitae to the Administrator, MRC Radiobiology Unit, Harwell, Didcot, Oxon OX11 0RD. Ref: JV/6.

ROYAL POSTGRADUATE MEDICAL SCHOOL

Department of Medicine

A GRADUATE

is required to join a highly successful small Group investigating peptide hormones and neurotransmitters in man. Knowledge in the areas of physiology, clinical biochemistry (radioimmunoassay) or peptide analytical techniques could be an advantage.

Salary not less than £4000 depending on age and experience.

Apply with full curriculum vitae and telephone number, if available, to Dr Stephen R. Bloom, Royal Postgraduate Medical School, 150 Du Cane Road, London W12 0HS.

Desk Editor

for Elsevier Sequoia

Required for work on specialised scientific journals in a rapidly expanding company. Applicants must have had university level training in the Physical Sciences or Engineering. A concern for literate communication and a good command of the English language are essential, as is the ability to work precisely and thoroughly under pressure.

The work entails the copy-editing of manuscripts and correction of proofs. The desk editor liaises with Academic Editors and authors as well as with our production department in Lausanne.

Application forms can be obtained by ringing Oxford 511385 or applications (handwritten) may be sent to:

The Office Manager,
Editorial Office (UK) of Elsevier Sequoia,
Mayfield House,
256 Banbury Road,
Oxford OX2 7DH.

UNIVERSITY OF LIVERPOOL

Department of Botany
Physiology and Biochemistry of Marine Fungi

Applications are invited from those with experience in microbial or higher plant physiology or biochemistry for the post of

POSTDOCTORAL SENIOR RESEARCH ASSISTANT (NERC supported)

to work on the physiology and biochemistry of marine fungi with Professor D. H. Jennings. The post is available on 1 October 1980 for one year in the first instance, but may be renewed for a further two years.

Initial salary £5052 per annum.

Applications, together with the names of three referees, should be received not later than 11th July, 1980, by The Registrar, The University, PO Box 147, Liverpool L69 3BX, to whom further particulars may be obtained. Quote Ref: RV/45/NS.

UNIVERSITY OF ST. ANDREWS

Department of Psychology

Applications are invited for a

LECTURESHIP IN SOCIAL PSYCHOLOGY

tenable from September/October 1980. Whitehead candidates should have advanced training in social psychology and a research degree, those holding existing appointments in related Social Sciences will also be considered.

Salary at appropriate point on scale £5052 to £10 484 (under review), starting salary probably not above £7410, plus FSS/U.S.S.

Applications (two copies preferably in triplicate) with the names of three referees should be lodged by 31 July, 1980 with the Establishments Officer, The University, College Gate, St. Andrews, Fife, from whom further particulars may be obtained.

ANALYST TECHNICIAN

Grade 4 required in Department of Geology, University of Reading. Experience in analysis of rocks and/or soils (for inorganic components) by wet chemical methods desirable, but applicants with appropriate experience in general inorganic analysis by atomic absorption, colorimetric and other techniques also considered. Salary in scale £3348-£4545 p.a. (under review). Apply for further details and application form to The Personnel Officer, University of Reading, Whiteknights, Reading RG6 2AH quoting Ref. T.S. 17A.

UNIVERSITY OF LIVERPOOL INSTITUTE OF CHILD HEALTH ALDER HAY CHILDREN'S HOSPITAL

TECHNICIAN (GRADE 5)

To assist with research. Work includes assistance with design and development of medical electronic instruments and operating the Institute's digital computer. Applicants must possess ONC or equivalent as minimum qualification and be experienced in fault diagnosis and use of digital and analogue integrated circuits. Knowledge of programming an advantage. Salary in a range £4257-£4974 p.a.

Application forms may be obtained from The Registrar, The University, PO Box 147, Liverpool L69 3BX. Quote Ref: RV/44/NS

UNIVERSITY OF ABERDEEN LECTURESHIP IN STATISTICS

Applications are invited for the above post. The candidates interest may be in any branch of theoretical or applied Statistics.

Salary on scale £5052-£10 484 per annum with appropriate placing.

Further particulars from The Secretary, The University, Aberdeen, with whom applications (two copies) should be lodged by 11 July, 1980.

CANCER RESEARCH

"What can I do to help?" Everyone has asked that question—the answer is that you CAN help to fight cancer. The Imperial Cancer Research Fund, the largest independent cancer research centre in Europe relies solely on voluntary contributions. Please send your donation to:

IMPERIAL CANCER RESEARCH FUND
Room 542W, P.O. Box 123,
Lincoln's Inn Fields, London WC2A 3PX.

TECHNICIAN

(one year with possible extension) required for research project in ultraviolet radiation and skin cancer. Applicants should be biologists with interest/experience in computing. Suitably qualified candidates would be encouraged to apply for an MPhil. Salary (under review) from £4525. Send brief curriculum vitae to Dr A. Young, Institute of Dermatology, Homerton Grove, London E9 6BX.

MANCHESTER POLYTECHNIC Institute of Advanced Studies

RESEARCH ASSISTANTS

Applications are invited from people with a background in Industrial Design, Engineering, Management Science, Technology Policy etc. to work in one or more of the following areas:

- Domestic Heat Pumps
- The Effects of Technological Change
- Design of Surgical Instruments
- Applications and techniques for Bimetallic Steel
- Evaluation of Drug Dispensing Machines
- Computing test processing language design (SRC 1980).

The Institute of Advanced Studies is an inter-disciplinary research centre where people from different backgrounds attempt to collaborate in the solution of real world problems. Opportunities exist for higher degree registration.

Salary scale: £4101-£4645.

Further particulars and application forms obtainable from Dr John Langford, Dean, Institute of Advanced Studies, Manchester Polytechnic, All Saints, Manchester M14 6PL. Tel: 061 275 8771 ext. 2267. Please quote reference number 8/988.

SUTTON HIGH SCHOOL FOR GIRLS

Required in September

GRADUATE

to teach Physics throughout the school up to Advanced Level. This position could be filled by one full time or two part time applicants. Apply to the Headmistress, Sutton High School for Girls, (SPDS), 55 Cheam Road, Sutton SMI 2AX, with curriculum vitae and two academic referees as soon as possible.

UNIVERSITY COLLEGE SCHOOL

require a Chemistry Laboratory Technician according to age, qualifications and experience. Apply by letter to the Senior Science Master, University College School, Frognal, Hampstead, London NW3 6XH.

STUDENTSHIPS

University of Cambridge
Department of Physics

STUDENTSHIPS

Applications are invited for PhD studentships (including SRC CASE awards) in the following fields:

- Turbulence in various flow conditions.
- Amorphous thin films.
- Silver catalysts.
- Low temperature semiconductors.
- Surface interactions.

Optics of oxide glasses.
Breakdown of solid electrolytes.
Analysis of Antarctic atmospheres.
Optimization of wind turbine blades.

Please write or telephone without delay to Mr J. Dunlop, Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE. Tel. 0223 44477.

THE POLYTECHNIC OF CENTRAL LONDON

School of Engineering and Science
SRC STUDENTSHIP IN MICROBIOLOGY

Applications are invited from suitably qualified graduates to work for three years on the development of a new vaccine. The emphasis is on the laboratory study of bacteria and on the development of a vaccine. A 20% degree in a relevant discipline is required and candidates will be able to register for a CMAA higher degree (MPhil PhD).

Application form and further details from The Establishments Officer, Microbiology, Regent Street, London W1R 6AL (Tel. 01-582 5505 ext. 210).

LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

Applications are invited for research studentships in the analytical group of the University's Department of Chemistry.

BIOCHEMISTRY

An SAC studentship awarded by the Analytical Division of the Chemical Society for the study of new immunological methods using metal ions as labels. Grant at SRC rates with additional benefits.

ENVIRONMENTAL CHEMISTRY

An SRC CASE studentship in co-operation with Unilever Research, Port Sunlight, developing electrochemical methods of determining phosphates and silicates in effluents.

Applicants should write with details and evidence of referees to Dr J. N. Miller, Department of Chemistry.

Loughborough

Leicestershire

CHARING CROSS HOSPITAL MEDICAL SCHOOL RESEARCH STUDENTSHIP

Applicants should hold or expect to obtain a degree in physiology, biochemistry or pharmacology, with first or upper second class honours, and wish to work in the clinical fields of atheroembolism and cerebral infarction. Some previous acquaintance with chemistry will be helpful. The successful candidate will work alongside research clinicians in the Charing Cross Hospital Department of Neurology and will be expected to develop with training a programme of research with a view to submitting a thesis for the Ph.D. degree.

The studentship is, in principle, tenable for up to 3 years; it will, however, be subject to review towards the end of the first year and continuation will be dependent on progress. The terms of the studentship will be broadly similar to those applied by the M.R.C.

Please write, enclosing a curriculum vitae and three referees, to: Dr F. Clifford Rose, Physician-in-Charge, Department of Neurology, Charing Cross Hospital, Fulham Palace Road, London W6 8RF.

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION SRC/SRRC RESEARCH STUDENTSIPS, 1980-81

Applications are invited from honours graduates wishing to pursue research leading to either a MPhil or PhD degree, on problems bearing upon the social, economic and educational dimensions of recent scientific and technological development. Particular attention will be given to studies which focus upon the definition of policies for school—and out of school—education and which consider professional and educational implications arising from the introduction of new technologies.

For further details, contact the Secretary, Science Education Department, University of London, Institute of Education, 20 Bedford Way, London WC1H 0AL. Apply as soon as possible.

Details of admission requirements may be obtained from the Deputy Academic Registrar.

UNIVERSITY OF BRADFORD Postgraduate School of Chemical Engineering and Manufacturing Systems Engineering SRC/REDFERN NATIONAL GLASS INDUSTRIAL RESEARCH STUDENTSHIP

Applications are invited from graduates in engineering, applied science or physics holding a First/Upper Second Class Honours Degree from a British university for a three-year industrial studentship to study computer-aided interactive modelling and control of flow and heat transfer processes in glass laboratories. The project offers an excellent opportunity to participate in the development of mathematical models and micro-computer control of molten glass in fibreglass, which is of vital importance to the manufacture of glass containers. The applicants should be eligible for the award of an SRC Industrial Studentship. The grant will be supplemented by Redfern National Glass, and the starting salary will be in the range £500 to £550 p.a. depending on qualifications and experience.

Further particulars and application forms can be obtained from the Secretary, Postgraduate School of Chemical Engineering and Manufacturing Systems Engineering, University of Bradford, Bradford, BD7 1DP. Tel: Bradford (0274) 33666. Ext. 3433. Please quote Ref: RS/ME/2/NS.

UNIVERSITY OF KENT AT CANTERBURY Biological Laboratory NERC STUDENTSHIP

Applications are invited for a NERC Research Studentship concerned with the interactions of microorganisms, enzymes and substrates in aquatic sediments, and under the supervision of Dr B. G. Burns.

Applicants must already hold or expect to obtain a first or upper second class honours degree in biochemistry, microbiology or a related discipline.

The studentship will be tenable from 1 October 1980. Further details and application forms can be obtained from the Senior Assistant Registrar, Faculty of Natural Sciences, The University, Canterbury, Kent CT2 7NH to whom applications should be sent by 14 July, 1980. Please quote ref: PG19/80.

UNIVERSITY OF BATH School of Physics

RESEARCH STUDENTSIPS

Applications are invited for a University Research Studentship leading to a PhD degree for a computational project on the electronic structure of solids. Tasks are of a similar nature to SRC awards. A further studentship is available for research in solid state mechanical and acoustic emission.

Please write to Dr D. W. Bullett, School of Physics, University of Bath, Claverton Down, Bath BA2 7AY.

ROYAL POSTGRADUATE MEDICAL SCHOOL (University of London) MRC STUDENTSHIP

The Department of Histochimistry has a vacancy for a recent graduate to work on morphological aspects of peripheral neuroendocrine regulation.

Apply with full curriculum vitae to Dr J. Polak, Royal Postgraduate Medical School, 150 Du Cane Road, London W12 0BS.

THE UNIVERSITY OF SHEFFIELD DEPARTMENT OF METALLURGY SRC CASE Studentships

Applications are invited from men and women for seven SRC/CASE studentships tenable from 1 October 1980, for research in the following fields:

- (a) In co-operation with Spring Research and Manufacturers Association, Sheffield "Effect of Hot Pre-Stressing on Reduction in Spring Relaxation"
- (b) In co-operation with GKN Group Technological Centre, Wolverhampton "Fatigue Properties of Ferritic Cast Irons"
- (c) In co-operation with CGB, Scientific Services Division, Gravesend "Void Assessment in Materials with Changing Structure"
- (d) In co-operation with Alcan Laboratories Ltd., Capenhurst "Properties of Spray-Formed Materials"
- (e) In co-operation with National Physical Laboratory, Teddington "Experimental Verification of Recent Cavity Growth Models"
- (f) In co-operation with The British Rail, Derby "Weldability of Rail Steels"
- (g) In co-operation with Rolls-Royce Limited, Bristol "Rapid Solidification of Superalloys"

Applicants with or expecting good honours, Degree in Metallurgy, Materials Science or related fields should write to Professor G. J. Davies, Head of the Department of Metallurgy, the University, Sheffield S1 3JD. Quote ref. no. R470/H.

UNIVERSITY OF WARWICK RESEARCH STUDENTSHIP IN BIOCHEMISTRY

Applications are invited for a three-year CASE (PhD) research studentship in the Department of Chemistry and Molecular Science Research Council and Imperial Chemical Industries, Pharmaceutical Division.

The project which will be carried out in collaboration with Dr B. E. P. Swoboda and Dr J. F. Ryley, is a comparison of RNA synthesis in a yeast cell, *Candida albicans* with that in mammalian cells. The objective of the project is to develop specific inhibitors of RNA synthesis. *C. albicans* which will not affect RNA synthesis in the mammalian host and can therefore be used in the treatment of infection. Candidates must possess either a first or upper second class honours degree in biochemistry or a related subject. Application forms from the Academic Registrar, University of Warwick, Coventry CV4 7AL, quoting PG/38/80/F.

UNIVERSITY OF READING Department of Zoology SRC CASE RESEARCH STUDENTSHIP

One studentship is available for a study of the influence of the mechanical and mechanical properties of the beak on the feeding and survival of birds in captivity and in the wild. The project will be based at Reading, with time spent at The Wildfowl Trust, Slimbridge.

The candidate should have some knowledge of, or sympathy with, Physics and/or Engineering. Applicants who should have no experience to obtain a first or upper second class honours degree, should apply immediately quoting the names of two referees, to Dr J. F. V. Vincent, Department of Zoology, University of Reading, Whiteknights, Reading RG6 2AH.

UNIVERSITY OF WARWICK SRC CASE Studentships in Mass Spectrometry

Applications are invited from final year undergraduates and suitably qualified graduates for the following Research Council CASE Studentships in Mass Spectrometry to work in collaboration with Professor R. N. Jervis in the Department of Chemistry Molecular Sciences.

- (A) Analytical applications of linked scans in mass spectrometry in collaboration with the Petrochemical Division. The project will involve the use of a linked micro-computer to control the scanning mode of a Kratos MS50 research mass spectrometer and some familiarity with computer programming is desirable.
- (B) A chemical ionisation mass spectrometry study of organometallic compounds in oil and related materials. The project will involve the use of both positive and negative ion modes and will be carried out using both a Kratos prototype MS50 and a recently installed Kratos MS50/585 mass spectrometer and data system.

Each Studentship is for a period of three years and is available for students who possess a first class honours degree, a first class or upper second class honours degree in chemistry or a related subject and who have been in the field for the past three years in the United Kingdom.

Applicants should send the names of two referees, should be sent as soon as possible to Dr J. N. Miller, Department of Chemistry and Molecular Sciences, University of Warwick, Coventry CV4 7AL.

UNIVERSITY OF KENT AT CANTERBURY BIOLOGICAL LABORATORY GRADUATES

Applications are invited from Honours or Upper Second Class Honours degrees in biochemistry, physiology or related subjects. Research Council CASE studentships leading to the degree of Ph.D. in the following research areas:

- (a) Mode of action of antimetabolites
- (b) mammalian enzymes involved in metabolism of xenobiotics
- (c) effects of xenobiotics on gene expression in liver
- (d) microbial proteins in lower eucaryotes
- (e) genetic degradation by bacteria
- (f) genetics of methane-oxidising bacteria.

Candidates should apply giving details of qualifications and the name of an academic referee to the Senior Assistant Registrar, Faculty of Natural Sciences, Chemical Laboratory, The University, Canterbury, Kent CT2 7NH by 14 July 1980. Please quote ref: PG 38/80.

UNIVERSITY OF EAST ANGLIA SCHOOL OF BIOLOGICAL SCIENCES

Membrane Transport Processes in Alkaliphilic Bacteria

Applications are invited for an

SRC CASE Research Studentship

for this project held between Dr M. J. Selwyn at the University and Dr B. H. Hirst at the SRC Food Research Institute, Norwich.

Applicants should be, or expect to be, holders of a first or upper second class honours degree in Biological Sciences, or in Microbiology with subsidiary biochemistry, and should submit a curriculum vitae with the names of two academic referees to Dr M. J. Selwyn, School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, as soon as possible.

UNIVERSITY OF STRATHCLYDE

**SRC CASE
Studentships:
MATERIALS STUDIES**

Applications are invited from candidates with or expecting a good honours degree in Physics, Chemistry, Materials Science or Metallurgy for a 3-year SRC CASE studentship to study surface reactions of aluminium alloys using x-ray photoelectron spectroscopy. The research, which is to be undertaken in conjunction with British Aluminium Company, will lead to the degree of PhD. Predominantly the work is based at Strathclyde but the student will spend periods (totaling 4 months over the 3 years) at the R.A. Research Laboratories, Chalfont, Buckinghamshire. SRC postgraduate scales apply but additionally British Aluminium Company will award to the successful candidate a supplementary grant (of up to £750 per annum) plus travel and accommodation expenses when away from Strathclyde.

Applications should be addressed to:

Dr D. J. Fabian
Department of Metallurgy
University of Strathclyde
Glasgow G1 1XN.

UNIVERSITY OF ST ANDREWS
Department of Biotechnology
and Microbiology

**Postgraduate
Studentship in
Biochemistry**

Applications are invited for a postgraduate studentship financed by the National Fund for Research into Crisping Diseases. The project will involve studying the molecular mechanisms underlying the inherited metabolic disorder, homocystinuria. The research methodology involved in the project will be multidisciplinary.

The three-year studentship will commence from October 1980. Candidates should hold, or expect to obtain in 1980, a first or upper second class Honours Degree in Biochemistry.

Applications, together with the names and addresses of two referees, should be sent to Dr R. Griffiths, Department of Biochemistry, University of St Andrews, North Street, St Andrews, Fife.

IMPERIAL COLLEGE OF SCIENCE
AND TECHNOLOGY
(UNIVERSITY OF LONDON)

Postgraduate Research in Analytical Chemistry

**Two CASE
Studentships**

Applications are invited from persons holding, or expecting to obtain, a first or upper second class Honours Degree in chemistry, physical/analytical engineering, or a related subject, to carry out research for a three year period into:

- The Development of Porous Toxic Gas Detectors for use on board ships (based on coated alloyed crystals). In collaboration with Paceson Anco Ltd.
- The Design and Development of a Microarray Cavity Resonator for Gas Analysis, in collaboration with Tek Instruments Ltd. (Analytical).

Applicants should have good aptitude for Electronic Construction and an interest in Microprocessor Control of Instrumentation. The successful candidate will register for PhD and financial provision will be assessed at the current SRC rates.

Applications with curriculum vitae and the names of two referees should be sent to Dr J. F. Alder, Chemistry Department, Imperial College, London SW7 2AY before 1 August, 1980.



UNIVERSITY OF
SOUTHAMPTON

**Research in Applied
Electrostatics**

The following SRC/CASE studentships are available for commencement in October 1980.

**1. Electropainting Co-operating
body—International Paint Co.**

This is a widely used industrial process; the programme will include a study of the fundamentals of the process, in which interest will be between electrostatics and electrochemistry. Analysis of results is likely to include computer programming.

**2. Electrostatic Aerosol
Charging Co-operating body—British
Aerosol Manufacturers Association**

The filling of certain pressure packed aerosol containers can cause dangerously high levels of static charging. Programme will include detailed study of charging during atomisation and identification of static-free container.

**3. Web Charging in Nip
Rollers Co-operating body—Imperial
Chemical Industries**

High velocity handling of insulating webs frequently results in high levels of charge separation. The charging at nip rollers is of special interest to web manufacturers and film and tape handling systems. Programme will include both theoretical and practical approach.

**4. Dry Copier Systems
Co-operating body—Gestetner Ltd.**

New types of dry powder electrophotographic copying systems are currently under development. Programme will include both theoretical and practical approach to powder charging and manipulation in electric fields.

Grant supplement available in most cases.

For further information on Project 1 contact Professor W. D. Allen, Projects 2, 3 and 4 contact Dr J. F. Hughes, Dept of Electrical Engineering, University of Southampton, SOUTHAMPTON. Tel: 0703 559122 Ex 398. Quote reference N.Sc.

UNIVERSITY OF CAMBRIDGE

**SRC CASE and CTA Studentships in
ANIMAL NUTRITION**

Applications invited from graduates in Biological and Agricultural Sciences for:

- 3-year SRC CASE Research Studentship for study of digestive physiology of the Oryx.
- Lower CTA Studentships (applied for) for study leading to PhD of:
 - digestive physiology of *Muntiacus reevesi*.
 - recognition times of plant cell walls in rumen of sheep and cattle.

Qualifications: possess, or expect at least Upper Second Class Honours degree or equivalent. Further details on request.

Applications with CV and names/addresses of two referees, to: Dr R. L. Miller, Department of Applied Biology, Pembroke Street, Cambridge CB2 3DQ.

UNIVERSITY OF LANCASTER

Department of Environmental Sciences

Applications are invited for

**Two SRC Case
Studentships**

tenable from October 1980 to work for a PhD degree on the following topics in the field of atmospheric pollution:

- Discrimination of Sources of Atmospheric Lead (CASE studentship with RTZ Services Ltd).
- Rainout Processes in the Atmospheric Oxidation of Sulphur Dioxide (CASE studentship with Central Electricity Generating Board).

Further details from Dr R. M. Harrison, Dept. of Environmental Sciences, University of Lancaster, Lancaster LA1 4YQ (Lancaster 6520), Ext. 4191).

UNIVERSITY
COLLEGE OF
SWANSEA

CASE Studentships

Applications are invited for two

**SRC CASE
STUDENTSIPS**

expected to last to PhD degree in Organic Chemistry. One project concerns the synthesis of novel macrocyclic lactones (macrolides) with potential central nervous system activity, and is in collaboration with Pfizer Central Research, Sandwich. The other concerns the synthesis of novel heteroatomic systems containing four-valent sulphur, and is in collaboration with ICI Organics Division, Blackley. Candidates should have, or expect to obtain, a 2(i) Honours degree or its equivalent, in Chemistry, Pharmacy or a related subject. Applications, stating age, qualifications and experience, and giving the names of two referees, should be sent as soon as possible to Dr Keith Smith, Department of Chemistry, University College Swansea, Swansea SA2 8PP.

UNIVERSITY OF OXFORD

Department of Engineering Science

**SRC Case Studentships
in Physical Electronics**

Applications are invited from electronic and electrical engineers and physicists for two CASE Studentships to commence on 1 October, 1980. The following SRC supported projects:

- The formation of conventional and novel acoustic components by volume holography.
- The investigation of a new range of acousto-electronic devices for signal processing which utilize bulk acoustic waves.

In both cases, the successful applicant will receive the normal SRC award supplemented by the Industrial Sponsor. Applicants should possess or expect to obtain a First or Upper Second Class Honours degree and should write to Professor E.G.S. Paley, Department of Engineering Science, University of Oxford, Parks Road, Oxford, OX1 3PJ, as soon as possible, giving the names of two referees.

UNIVERSITY OF BRADFORD

**RESEARCH
STUDENTSIPS**

IN PHARMACEUTICAL SCIENCES:
SRC CASE AND QUOTA AWARDS

Opportunities exist for students to undertake postgraduate research leading to the PhD degree, commencing October 1980. Programmes will involve research in one of the following areas:

- Drug absorption in human skin.
- Interaction of drugs with bile salts.
- Powder technology.
- Biopharmaceutics of antibiotic oil suspensions.
- Pharmacokinetics.

Applicants should possess a good honours degree in pharmacy or chemistry, or expect to gain one this year, with a particular interest in pharmaceuticals or physical/analytical chemistry. Interested persons should write to Professor B. W. Berry, School of Pharmacy, University of Bradford, West Yorkshire, BD7 1DQ, stating their particular interest(s), qualifications and areas of research, with names and addresses of two academic referees. Please quote Ref: RS/PS/1/NS.

UNIVERSITY OF KENT
AT CANTERBURY

Research Studentships

are available in
RADIO ASTRONOMY
SPACE SCIENCES
ANTENNA STUDIES

RADIO ASTRONOMY: research is directed towards the study of regions of star formation through observations of the molecular line emission at millimetric wavelengths. Observational facilities include the 5m radio telescope at Chilbolton, Hants and the 3m UK infrared telescope at Mount Kite, New Zealand.

SPACE SCIENCES: investigations involve instrumental development and theoretical studies of cosmic dust on the first NASA Space Shuttle mission, the Shuttle Long Duration Exposure Facility and the International Solar Wind Mission. Instrumentation involving microprocessors is being developed also for proposed ESA Missions, namely Lunar Polar Observatory and the mission to Intersect Comet/Halley in 1986. An active NASA/USRS Lunar sample programme under the 28V Van de Graaff accelerator centre on the planetary and solar environment, hypervelocity impact, solar wind interactions and lunar surface development.

ANTENNA STUDIES: the studentship is available for a theoretical study of the interaction of electromagnetic waves with periodic structures and frequency sensitive surfaces, together with the application of these surfaces to advanced feed systems for reflector antennas. The project is closely related to existing research in antenna theory. Applications from candidates who expect to obtain a first or upper second class degree in physics, the electrical sciences, or applied mathematics should be addressed to the Senior Assistant Registrar, Faculty of Science, University of Canterbury, Kent CT2 7NH quoting ref: PG 18/80.

UNIVERSITY OF KENT AT CANTERBURY

RESEARCH STUDENTSHIP IN THEORETICAL COLLOID SCIENCE

Applications are invited for a CASE studentship tenable from October 1980. The successful applicant will work under the joint direction of Professor G. Rickayzen of the University and Dr P. Richmond of Unilever Research Ltd on a theoretical study of the forces between colloidal particles. The terms and conditions of the award are those laid down by the Science Research Council. Applicants, who should possess (or expect to obtain) a first or upper second class degree in Physics, Chemistry or an allied subject, should write to Mr J. S. Cowie, Senior Assistant Registrar, Chemistry Laboratory, The University, Canterbury, Kent CT2 7NH, from whom application forms may be obtained. Please quote ref: PG17/80.

LEICESTERSHIRE UNIVERSITY OF TECHNOLOGY

ORGANIC SYNTHESIS RESEARCH

Applications are invited for an SRC CASE studentship in collaboration with the Boots Company (Nottingham). The industrial supervisor will be Dr J. S. Nicholson. The studentship is available for up to three years. The successful candidate will register for a higher degree and should have an honours degree. The work involves the preparation of novel heterocyclic ring systems via aromatic substitution. Applications with full details, including references, to Dr W. R. Bowman, Department of Chemistry, Leicestershire

Loughborough

Leicestershire

UNIVERSITY OF ST ANDREWS
Department of Biochemistry and Microbiology

MSc Studentship in Biochemistry

Applications are invited for a MSc research studentship in the above department. The project will involve studies on the mechanism of action of certain sulphur-containing compounds in the production of convulsive seizures. Primarily the effects on the phosphate-dependent enzymes of the GABA pathway in mammalian brain will be considered.

The one-year studentship (with the possibility of a further two-year extension) will commence as soon as possible after 1 October, 1980. Candidates should hold, or expect to obtain in 1980, at least a second class Honours Degree in Biochemistry or a related subject.

Applications, together with the names and addresses of two referees, should be sent to—Dr R. Griffiths, Department of Biochemistry, University of St Andrews, North Street, St Andrews, Fife.

UNIVERSITY OF SUSSEX CASE STUDENTSHIP IN PHYSICS

Applications are invited for a studentship leading to a D.Phil. degree in the field of integrated optics using the technique of ion implantation. The emphasis will be on the underlying physics of this rapidly expanding area of technology. The studentship will spend time both at Sussex and the Telecom Research Laboratories, Martlesham Heath.

The value of the award will be the standard SRC CASE Studentship plus an additional contribution from the Telecom Research Laboratories of £765 per annum.

Applications should be addressed to Dr P. Townsend, School of Mathematical and Physical Sciences, University of Sussex, Brighton, BN1 9QH.



ROYAL SOCIETY/SCIENCE RESEARCH COUNCIL INDUSTRIAL FELLOWSHIP

Fellowships are offered under a new joint Royal Society/SRC Scheme designed to improve communication on science and technology between those in industry and in universities and polytechnics to the benefit of United Kingdom firms or universities. The scheme enables academic scientists, mathematicians and engineers to hold a job and undertake a project in an industrial environment and provides similar opportunities for industrial scientists mathematicians and engineers to carry out research or course development in a university or polytechnic.

Candidates of PhD status or equivalent, ordinarily resident in UK, Channel Islands, Isle of Man, are invited to submit proposals for awards of from 6 months to two years support. There are no age limits but preference will be given to candidates within an age range of 30 to 45 years. Projects should be within the field normally supported by SRC and involve transfer to work in the alternative sector of employment to that of the candidates' existing employment, which they will retain.

Application forms and regulations may be obtained from the Science Research Council, PO Box 18, Swindon, SN2 1ET (Tel Swindon (0973) 26222 Ext 2172).

Applications may be made at any time and results will be announced within 4 months of application.

FELLOWSHIPS, GRANTS, SCHOLARSHIPS

UNIVERSITY OF STRATHCLYDE

Applications are invited from

Physicists, Chemists or Electrical Engineers

holding a PhD degree, or about to obtain one, for a RESEARCH FELLOWSHIP in LASER PHYSICS in the DEPARTMENT OF PHYSICAL PROSODY to work on a Carbon Dioxide TEA laser contract.

Appointment for two years in the first instance on Range 1A of the national salary structure for research and analogous staff, commencing salary scale £3380-£6062 per annum (under review). Superannuation benefit.

Applications (quoting R32/80) including a curriculum vitae and the names of two referees should be sent as soon as possible to Professor A. L. S. Smith, Department of Natural Philosophy, University of Strathclyde, John Anderson Building, 167 Rottenrow, Glasgow G4 0NG from whom further particulars can be obtained.

UNIVERSITY OF SOUTHAMPTON CRC Medical Oncology Unit CLINICAL RESEARCH FELLOW

Three year training Fellowship in Medical Oncology available immediately. Candidates must possess MRCP and have achieved Registrar status (or above).

Further details can be obtained by telephoning Southampton 777222, ext 4297.

Applications (two copies) including full curriculum vitae and the names of two referees should be sent to Mrs P. Vaughan-Smith, Staffing Department, The University, Southampton SO9 5NH, as soon as possible.

Please quote ref: 1141/R/NS.

UNIVERSITY OF WARWICK POSTDOCTORAL FELLOWSHIP IN BIOLOGICAL SCIENCES

Applications are invited for a Postdoctoral Fellowship, funded by the Cancer Research Campaign, to work in the Virus Research Group in the Department of Biological Sciences. The Research Fellow will be expected to develop research on the role of interferon in murine sarcoma/leukaemia virus infection. Aspects of particular interest are the molecular mechanism of interferon's inhibition of γ -transformation by MSV, interferon's effect on the *in vitro* phenotype of transformed cells and the interaction of interferon with the immune response in animals rejecting MSV/MLV induced tumours. The post, which would suit a person with experience in virology, cell biology or immunology, is available from 1 October, 1980, and is renewable on an annual basis to September 1983. Starting salary will be at the appropriate point on the Research Ranges 1A scale: £5052-£8769 per annum.

Further particulars and application forms are available from the Academic Registrar, University of Warwick, Coventry CV4 7AL; quoting Ref No: 45/1/80/F.

LECTURES, MEETINGS AND COURSES

UNIVERSITY OF LONDON MSc IN RADIATION PHYSICS

This course in medical applications of Radiation Physics is run jointly by the Physics Departments at the Middlesex and St Bartholomew's Hospitals. For full-time students the course is one year and for part-time students two years. The normal entry requirement is a First or Second Class Honours Degree with Physics as a major component.

The MSc course covers basic radiation and nuclear physics and applications in radiotherapy, radiology, nuclear medicine and health physics.

MRC and SRC grants are available for full-time students. Enquiries and applications to the Departmental Secretaries, Department of Physics Applied to Medicine, The Middlesex Hospital Medical School, Cleveland St, London W1P 6DB. Physics Department, Medical College of St Bartholomew's Hospital, Charterhouse Square, London EC1M 6BQ.

Polytechnic of the South Bank

MSc in APPLIED NUCLEAR PHYSICS

SRC approved

Applications are invited for this 1 year full-time or 2/3 year part-time course from candidates possessing an Honours Degree in Physics or equivalent.

Candidates who qualify for SRC Quota and Appeals Awards should apply as soon as possible. Quota nominations must reach SRCs by 31 July.

Full details from: Dr A. Haque, School of Physics, Polytechnic of the South Bank, Borough Road, London SE1 0AA. Tel: 01-728 8767 Ext. 2145.

ANALYSIS 80

The installation and management of micro and mini computers in the laboratory

A two-day conference at the Sudbury Conference Centre, 14 Newgate Street, London EC1. (near St. Paul's Cathedral) 29 & 30 September 1980.

An intensive review of current thinking and practice in the use of micro and mini computers in analytical laboratories. Topics will include reviews of available systems, selection of systems for particular needs, interfacing, software, and a number of user's case histories from leading laboratories.

Full details and registration forms are available from:-

Beverly Humphrey,
Scientific Symposia Ltd,
33-35 Bowling Green
Lane,
London EC1R 0DA, UK.
Tel: 01-837 1212
Telex: 299049 UTPRES G.

Middlesex Polytechnic A DE pcl The Polytechnic of Central London

Postgraduate Diploma in Air and Water Pollution Control (CNA)

Part-time, one day and evening a week
four terms starting 7 October

Applicants should normally possess a first degree or equivalent professional qualification in a branch of science or engineering.

For full details and an application form contact: Richard Braun, Middlesex Polytechnic, The Burroughs, Hendon, London NW4 4BT. Telephone 01-262 6545.

UNIVERSITY OF SURREY MSc IN NUCLEAR TECHNOLOGY

The MSc/Diploma course in Nuclear Technology is available on a one year, full time basis—or on a part time basis a week over two years. Applicants should have a good honours degree, or equivalent, in a relevant science or engineering discipline.

SRC studentships are available for suitably qualified applicants.

Details and application forms from:

Professor M. B. Waldron, Department of Metallurgy and Materials Technology, University of Surrey, Guildford, Surrey GU2 5XH.

Portsmouth Polytechnic MSc in MICROWAVE SOLID STATE PHYSICS

A one-year sandwich/full-time course with a project in industry or the Polytechnic. Candidates should hold an Honours degree in Physics, Electronics or Electrical Engineering. SRC Advanced Course studentships may be obtained. Sandwich mode students are normally paid up to £1000 during their project in industry.

For further details please write or phone to: Administrative Assistant, Department of Physics, King Henry 1st Street, Portsmouth Polytechnic, Portsmouth PO1 2OZ. Portsmouth (0705) 37461 Extension 138.

Thames Polytechnic MASTER OF SCIENCE & POSTGRADUATE DIPLOMA in CHEMICAL ANALYSIS in Part-time Study

The MSc course has been recognised by the SRC for the award of Part-time Bureau Status.

Further information from:

The School of Chemistry, Thames Polytechnic, Wellington Street, London SE18 6PF.

Tel: 01-854 2030, extn. 311.



Southampton
THE UNIVERSITY

INSTITUTE OF CRYOGENICS

Incansive Short Course in Cryogenics

8-19 September, 1980

This residential course is designed for graduates in science and engineering, or persons with similar qualifications, as an introduction to the industrial application of cryogenics. No previous knowledge of cryogenics or low-temperature physics is required. The temperature range covered is above 70K. Further details from the Secretary, Institute of Cryogenics, The University, Southampton SO9 5NH. Telephone (0703) 559 122 Ext. 2059.

QUEEN MARY COLLEGE University of London MSc IN ASTROPHYSICS

This two-year part-time course starts in September 1980. Formal teaching will be on Friday evenings. A general course is taught during the first term and in the following five terms there will be specialised courses in Formation of Planetary Systems, Stellar Structure and Evolution, Galaxies, Galactic Structure and Cosmology, Nuclear Astrophysics, Far Infrared Astronomy. A practical or theoretical project runs through the two years.

Full details and application forms are available from Mrs M. E. Daniel, Physics Department, Queen Mary College, Mile End Road, London E1 4NS.

UMIST

POSTGRADUATE COURSE IN SOLID-STATE ELECTRONICS (M.Sc. and Ph.D.)

A 12-month course starts at UMIST in October each year. This course, which is suitable for graduates in Physics, Electrical Engineering or related subjects, is concerned with the design and behaviour of solid-state devices (such as transistors, integrated circuits, magnetic computer memories etc.) and the solid-state physics on which they are based.

The MSc course comprises two terms of lectures followed by a 5-month research project. Suitable candidates may be given the opportunity to proceed to PhD work.

The course is recognised by the Science Research Council, and has an association of their studentships.

Further information from Dr K. E. Singer, Department of Electrical Engineering and Electronics, UMIST, PO Box 88, Manchester M60 1QD.

COMPETITION

GET INTO SPACE

Competition for schools (up to 'A' Level).

Design and experiment to be carried into space on the US Orbiter Space Shuttle.

Details:

Miss J. MacBroom, Royal Astronomical Society, 4 Hamilton Place, London W1 (448-3515)

HOLIDAYS

WORLD-WIDE RELIABLE ECONOMY FLIGHTS

expert advice, instant quotations, Capricorn Travel, 27 Ebury Bridge Road, London SW1 01-730 6152.

FOR SALE

MEMORIAL UNIVERSITY OF NEWFOUNDLAND FACULTY OF MEDICINE ST. JOHN'S, NEWFOUNDLAND, CANADA FOR SALE BY TENDER

EDAX - E - EXTENDED SYSTEM

The Faculty of Medicine at Memorial University of Newfoundland wishes to dispose of the above system.

The EDAX - E - EXTENDED SYSTEM consists of:

- (1) EDAX MODEL XS-12-1692V detecting unit.
- (2) EDAX MODEL 707 B/B analysing unit.
- (3) EDAX MODEL 609A Epic Module.
- (4) EDIT/INT - BC NOVA 2/4 DATA PROCESSOR c/w EDIT/7 PROGRAMME T 173.

This equipment will be sold on an "as is - where is" basis and subject to Memorial University of Newfoundland conditions of sale. Purchaser will be responsible for all applicable taxes and shipping charges.

Further information pertaining to this equipment may be obtained by contacting Mr Philip Hyam, Faculty of Medicine, Telephone (709) 737-6438.

Tenders will be received up to 31 July, 1980 at the address shown below. Memorial University of Newfoundland does not bind itself to accept the highest or any tender.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND DEPARTMENT OF PHYSICAL OPERATIONS ST. JOHN'S, NEWFOUNDLAND ATTENTION: J. NURSE

Ariadne

■ There's no doubt that I don't have the expertise of some people in coping verbally with critical situations. I have noticed before that, according to reports, people are able to shout things, for instance, that I, on the other hand, would take long minutes even to say. "Long live the glorious revolution and death to the invading forces of reaction who will, in the end, be destroyed": sentiments of that sort.

Several days ago I was made to feel inferior again, this time by a report of the appearance of Lord Kagan in a French court. It said that policemen dragged him by his chains down a stairway. But he said over his shoulder and while being dragged, "The income tax people have plotted against me, of that there is no doubt..." and much more, to the length of several paragraphs. Any one who can include "of that there is no doubt" in remarks over his shoulder while being hauled away in irons deserves admiration.

Again according to the report, Lord Kagan has spent two months in Paris's Sauté prison. I must have been wrong all these years in thinking that only the Americans use the electric chair.

■ A report I saw said that an MP, whose name I forget, arranged a lunch at the House of Commons of which the first course was Yorkshire pudding. I always thought that in Yorkshire the pudding was served with nothing but gravy. However, on this occasion, it was served with a sauce. According to the report, it was served with union sauce. So much for the Harold Wilson tradition. Down with HP, the capitalist relish. Live up your meals with TUC. Stun your palate with NUM! It's so good, it's SOGAT!

■ A roomful of fanatics should be a frightening sight, but it depends on the subject of the fanaticism. Slipping through such a crowd like a trout in a stream, to quote the well-known chairman, I found it recently to be a pleasurable experience. The company were all mad about orchids.

There were so many of them that a person ignorant of all orchid knowledge—and I am one—could not even get a glimpse of the orchids on show. The room was hot and lit not only by fluorescent lighting, but also by the combined gleams of monomania flashing from every eye. There was an almost palpable atmosphere of cooperation, reciprocity, swapping. It was clear that orchid growers, orchid fanciers and all other species with anything even remotely to do with orchids were a shining example to us all.

I edged by two fanatics in conversation, one apologising to the other for telephoning at some unconscionable hour for information. "No matter," came the reply, "I'm always happy to talk to orchids about people at any time." It made sense, in the circumstances.

■ I wonder how many reverberations in the bladders of the world population followed the revelation that a Chinese surgeon had removed a stone in a bladder by blowing it up? Well, blowing it up is perhaps the wrong expression. By using an explosion is more accurate.

The patient felt a slight vibration and was numb afterwards, but for how long is not known. There are more details that I would like to know. What was the explosive? How was it touched off? Where was it placed? How big was the stone? How did it break up? And possibly the most interesting question, how did it all work out in the end? The sex of the patient must have been an important factor. Will these questions ever be answered?

■ Cigarette advertisements usually make no impression on me. Some reaction blanks them out. But I did notice one the other day for Rothman's. "Rothman's," it said. "The real king size".

Are there pretenders to that size? Is there a Rudolf Rassendyll size and how do you tell them apart? Has Colonel Sapt been suborned?

■ Last week my luciligrative friend Daedalus unveiled his "photon-buncher", which uses laser principles to take in the irregular stream of photons which is ordinary radiation, and re-emit it as clumps of photons. These travel like their individual components, but by multi-photon absorption act on a detector like one big photon of much higher energy (ie shorter wavelength). Thus beneath the DREADCO photon-bunching parasol, the dedicated Sun-worshipper will be able to tan in the duldest weather. The incoming visible photons will be bunched into pairs, each of ultraviolet energy, which will tan the skin as ultraviolet does, and appear to the eye—unimaginably—as ultraviolet would do if you could see it. Similarly, the new DREADCO fog-lamps and street lights emit photon-bunched infrared of wavelength long enough to penetrate fog, and illuminate the murkiest urban scene perfectly. But rather than rely on the unknowable sensations of multi-photon

They say it happens from too much reading of New Scientist



infrared vision, Daedalus recommends fluorescent goggles to convert incoming infrared photon bunches into equivalent single visible photons for easy viewing. Intense photon-bunched infrared may, however, have disquieting chemical effects. For a single infrared photon can set a molecule vibrating; the simultaneous arrival of a whole bunch of them would probably just break it apart. Of course any given frequency of infrared would affect only certain molecules with just the right resonances. Nonetheless, by bad luck, a pedestrian caught in the penetrating, photon-bunched, infrared beam might collapse with instant scurvy, every molecule of vitamin C in his body having been torn apart by molecular resonance. Or the happy drunk could find himself suddenly and inexplicably sober, his body-burden of alcohol having been blasted. Clearly, powerful new methods of selective chemical synthesis and radiation-therapy are opened up by this principle. But if the psychologists are right, and masculine aggression is a branch of the sex-drive, it could be a major force for peace. For a carefully tuned beam of photon-bunched infrared aimed at an aggressive army could wipe out all the testosterone from their bodies, destroying their warlike intent and leaving them with all the ingratiating sopiness of neutered tabbies.

The Magic Honeycomb



It's called PTCR (which stands for positive temperature coefficient of resistance) and it's basically a doped Barium titanate semiconductor material which exhibits a rapid rise in resistance at a determined switching temperature.

(See graph).

It has two main uses—air heating and air temperature detection.

Air Heating

The two flat surfaces of the honeycomb are coated with electrode material and connected to ac power up to 240v.

When current is switched on, the material leads to an equilibrium level, depending on the air current passing through the honeycomb pores.

Wattages are sufficient for a wide range of applications—for example in Hair Dryers, Portable Space Heaters, and various kinds of industrial 'warm-up' devices. Size, thickness and material formulation can all be adjusted to suit the specific job.

The many advantages include:—
Surprisingly high power from a single small heater.

Inherent temperature control and overheat protection.

No RF noise, no control devices, maximum safety.

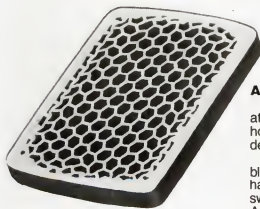
Air Temperature Detection

Because of the sharp change in resistance at the switching temperature, PTCR honeycombs are also ideal for temperature detection.

Apply a dc 'logic' voltage across the face, blow air through with a simple fan, and you have a remarkably efficient on-off detector switch, over a wide range of air temperatures. Applications are numerous; in electronic circuits, computer equipment, motor exhausts etc.

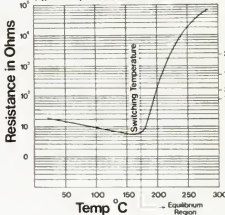
PTCR. It's an amazing new idea; a new tool; a new technology. Send for technical data.

Salford Electrical Instruments Ltd.
Peel Works, Barton Lane, Eccles,
Manchester M30 0HL.
061-789 5081. Telex: 667711.



Resistance - Temperature

(Typical Honeycomb Heater 50 Ø x 7MM)



Input Watts = 240 V.A.C.

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The logging of change has seen some changes.

Made by London clockmaker Cummins in 1766, the 'barograph clock' represented a major breakthrough in automatic data recording, charting the constant changes of climatic pressure as the clockface turned.

Today's technology brings you the range of Solartron Data Loggers designed to measure and record on-line data from your plant or experiment.

Now informed decisions can be made more easily in complex and constantly changing situations.

The range includes Loggers such as the Solartron Merlin which can reduce hundreds of repeated measurements to a single easily interpreted display.

Merlin plugs an off-the-shelf microcomputer into Solartron's 64-channel 3510 Integrated



Measuring System, outputting easy-to-interpret graphics on screen or paper.

Current data-logging technology is even better represented by Solartron's minicomputer-based System 35.

This versatile system is already meeting today's most exacting needs in research. It also has proven success in applications like automatic product testing, as well as monitoring power

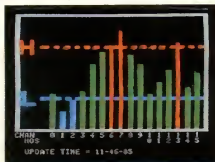
stations and nuclear installations.

At the other end of the scale the compact model 3430 portable logger brings Solartron technology to the source of the data, giving a flexible, low cost solution to your needs.

The 3430 has keyboard programming and handles up to 30 analogue and 20 digital channels. Hardware options include built-in strip print-out or tape cassette recording.

Whatever measurements you have to take and however you want to interpret them, the accuracy and sensitivity you'll need tomorrow is available today — from Solartron.

And, unlike so many other companies in advanced electronics, we'll take endless time and trouble to make sure you get the right answers to all your questions.



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